

---

# Contents

---

<b>1</b>	<b>Developing the UK's energy infrastructure</b>	<b>1</b>
1.1	The development of electric power	1
1.2	Regulating the industry	2
1.3	Coordinating the supply	3
1.4	Centralizing power stations	4
1.5	Managing the expansion	6
1.6	The Central Electricity Generating Board	6
1.7	Monopolies and private companies	7
1.8	Breaking up the monopoly	9
1.9	The effect of competition	10
Panel 1.1	Generators	12
Panel 1.2	AC/DC	13
Panel 1.3	Transformers	13
Panel 1.4	Power units	14
<b>2</b>	<b>The electricity system</b>	<b>17</b>
2.1	Supplying and delivering power	17
2.2	Generating power for the market	17
2.3	Power-station characteristics	18
2.3.1	Coal	18
2.3.2	Gas	18
2.3.3	Nuclear	19
2.3.4	Hydropower	20
2.3.5	Wind power	20
2.3.6	Coping with grid variation	21
2.4	The balancing market	24
2.5	Distribution network operators	25
2.6	Regulating the markets	26
<b>3</b>	<b>The heat connection and cogeneration</b>	<b>29</b>
3.1	Energy use in the UK	30
3.2	Support for heat and power	30
3.3	Energy crops	31
3.4	Domestic heating	32
3.5	Combined heat and power	32

3.6	Heat technologies	34
3.6.1	Biomass	34
3.6.2	Solar water heating	35
3.6.3	Ground-source heat	36
Panel 3.1	Ground heat in Cornwall	38
<b>4</b>	<b>Wind power</b>	<b>41</b>
4.1	Wind-turbine components	41
4.2	Assessing the wind resource	43
4.3	Installing a wind turbine	43
4.4	Rooftop turbines	44
4.5	Making the connection	46
Panel 4.1	Off-grid turbines	46
Panel 4.2	Wind across the Mersey	48
<b>5</b>	<b>Hydropower</b>	<b>51</b>
5.1	Power from water	52
5.2	The UK's hydropower potential	53
5.3	Assessing hydro sites	54
5.4	Environmental effects	55
5.5	Adding hydro to the system	56
5.6	Extracting the energy	56
Panel 5.1	Reviving old mills	57
Panel 5.2	Hydropower in Snowdonia	58
<b>6</b>	<b>Marine renewables</b>	<b>61</b>
6.1	Wave and tidal power	61
6.2	How much energy is there?	61
6.3	Distributed generation?	62
6.4	The route from research to industry	62
6.4.1	Marine Current Turbines	63
6.4.2	PowerBuoy	64
6.4.3	Pelamis	65
6.4.4	Fred Olsen	65
6.4.5	Limpet and Osprey	66
6.4.6	Stingray	66
6.5	Development issues	66
<b>7</b>	<b>Solar photovoltaics</b>	<b>69</b>
7.1	Photovoltaic power	69
7.2	Assembling the PV panels	70
7.3	Off-grid applications	71
7.4	Street applications	71
Panel 7.1	Sustainable Lambeth	74
Panel 7.2	Experience in Grimsby	75

<b>8</b>	<b>Combined heat and power</b>	<b>77</b>
8.1	The UK CHP programme	77
8.2	EU Directive support	78
8.3	Domestic CHP	79
8.4	Developing domestic technologies	80
8.5	Development issues	80
8.6	Who would buy?	82
Panel 8.1	Good projects on paper	83
Panel 8.2	London housing	85
<b>9</b>	<b>Biomass</b>	<b>87</b>
9.1	Biomass fuels	87
9.2	Heating programmes	88
9.3	Wood-energy strategies	89
9.4	Wood for Wales	90
9.5	Wood-fuel research	91
9.6	What is pyrolysis?	92
<b>10</b>	<b>Energy storage</b>	<b>95</b>
10.1	Diverse energy in the network	95
10.2	Pumped storage	96
10.3	Gas storage	98
10.4	Batteries	98
10.5	Centrifuges	99
10.6	Moving to a hydrogen economy	99
Panel 10.1	Norway's hydrogen experiment	100
Panel 10.2	Hydrogen in Iceland	102
Panel 10.3	Battery powered	103
<b>11</b>	<b>Fuel cells</b>	<b>105</b>
11.1	How fuel cells work	105
11.2	Fuel-cell configuration	106
11.3	Solid-oxide fuel cells	106
11.4	Fuel-cell applications	108
11.5	Developing the industry	109
<b>12</b>	<b>Interacting with the electricity grid</b>	<b>111</b>
12.1	Voltage and frequency	111
12.2	Voltage	111
12.3	Frequency	112
12.4	Reactive power	112
12.5	Maintaining the supply quality	113
12.6	Bringing on the reserve	114
12.7	Demand response	115
12.8	Dealing with transients	115

12.9	Transmission/distribution interaction	117
12.10	Adding microgeneration	119
<b>13</b>	<b>Making progress on policy</b>	<b>121</b>
13.1	Government strategy	121
13.2	Planning progress	122
13.3	Domestic changes	124
13.4	Scotland and Wales approach	125
13.5	A microgeneration strategy	126
13.6	Re-examining the remaining barriers	128
13.7	Licensing	129
13.8	Distribution and private wires	129
Panel 13.1	How planning works	130
<b>14</b>	<b>Embedded benefits</b>	<b>135</b>
14.1	Costs	135
14.2	Embedded benefits	136
14.3	New incentives	137
14.3.1	Innovation funding incentive	137
14.3.2	Registered power zones	137
14.4	Small generators	138
14.5	Consolidation	138
<b>15</b>	<b>Connecting and exporting power</b>	<b>141</b>
15.1	Connection standards	141
15.1.1	Step 1: Decide on your system	141
15.1.2	Step 2: Get a connection agreement	142
15.1.3	Step 3: Install suitable metering	142
15.1.4	Step 4: Install a ROC meter	142
15.1.5	Step 5: Arrange a tariff with your electricity supplier	143
15.2	The connection agreement	143
15.3	Rethinking the network	144
15.4	Shallowish connection	145
15.5	New charging regimes	146
15.6	Constraining connection?	147
<b>16</b>	<b>Finance and local generation</b>	<b>149</b>
16.1	Renewables Obligation	150
16.2	Electricity trading arrangements	152
16.3	Climate Change Levy	153
16.4	Grants	154
16.5	DEFRA support	155
16.6	DTI grants	156

<b>17</b>	<b>Changing the industry: ESCos and cooperative power ownership</b>	<b>159</b>
17.1	Energy-services companies	159
17.2	The 28-day rule	159
17.3	The affinity deal	162
17.4	The energy club	162
17.5	The CHP scheme	162
17.6	Thameswey	163
17.7	The legal framework	163
17.8	Community Interest Companies	164
17.9	Incorporation	164
17.10	Not-for-profit	165
17.11	Full cooperation	165
Panel 17.1	Baywind	166
Panel 17.2	Cooperative wind	167
<b>18</b>	<b>Output and generation</b>	<b>169</b>
18.1	Load factors and variability	169
18.2	Micropower efficiency	170
18.3	Progress of the field trial	171
18.4	MicroCHP for homes	171
18.5	Small-CHP for business	172
18.6	Replacing generation?	173
18.7	Saving carbon	174
18.8	Changing energy patterns	174
<b>19</b>	<b>Putting a price on carbon</b>	<b>179</b>
19.1	The EU Emissions Trading Scheme	180
19.1.1	Results from Phase 1	181
19.1.2	Setting up the ETS Phase 2	182
19.2	Trading outside Europe	183
19.3	Carbon trading for commerce and industry	184
19.4	Making the case for local energy	185
Panel 19.1	Greenpeace's wish list	186
<b>Bibliography</b>		<b>187</b>
<b>Index</b>		<b>189</b>