List of Figures, Tables and Boxes

FIGURES

II.1	Final energy consumption by sector in the EU	17
2.1	Solar heating and biomass plant, 5500m ² , Falkenberg, Sweden	20
2.2	Development of specific costs and installed capacity for small	
	solar thermal systems (forced circulation) in central Europe	22
2.3	Development of solar thermal market per capita 1998–2008	24
2.4	European solar thermal capacity per capita 2008	24
2.5	Residential building block in Denmark with flat-plate collectors	25
2.6	Shares of the European solar thermal market	25
2.7	Solar thermal market in EU-27 + CH	26
2.8	Residential building (Austria) with flat-plate	
	collectors	26
2.9	Large (custom-built) flat-plate collector being lifted/installed	
	on to roof in Germany	27
2.10	Production of vacuum tube collectors in Europe	28
2.11	House with flat-plate collectors on the roof (Germany)	32
2.12	Spanish house with thermo-siphon system on the roof	34
2.13	House with vacuum tube collectors installed on the facade	37
2.14	Solar thermal capacity in Europe	38
2.15	Collector field on the roof of a commercial building	38
3.1	RES distribution per sector	41
3.2	Biomass fraction of heat production	41
3.3	Biomass fuels conversion to bioenergy	42
3.4	Biomass to bio-heat	44
3.5	Gross heat production from biogas in the EU in 2006 and 2007I	
	(in Ktoe)	47
3.6	Pellet boiler with integrated flue gas condensation (efficiency	
	103%, nominal capacities 8, 10, 15 and 20 kW)	50
3.7	Reported retail prices in June 2005 without VAT	51

3.8	Pellet production in Europe towards 2020	52
3.9	European markets for residential heating systems	52
3.10	Comparison of international pellet markets (2006)	53
3.11	Impact of removal of subsidies on boiler sales in Germany 2006	57
3.12	Annual demand of biomass heating in the Scandinavia area	57
3.13	Biomass targets by 2020	58
3.14	Bioenergy allocation EU-25	60
3.15	Bioenergy potential EU-25	61
4.1	Small heat pump for single family house	64
4.2	Large heat pump in an office building	65
4.3	Types of GHP used: Closed systems – horizontal collector (left),	
	borehole heat exchangers (centre); and open system (right) – and	
	groundwater wells	65
4.4	Small residential house	66
4.5	Its GHP system	66
4.6	Large office complex	67
4.7	Its GHP system	67
4.8	Supermarket in Austria	68
4.9	Its GHP system	68
4.10	Structure of a GHP system for snow-melting and de-icing	69
4.11	Borehole Thermal Energy Storage in Neckarsulm, Germany	69
4.12	Solar collectors and buffer storage for small DH network	
	with BTES	70
4.13	ATES for Prins van Oranie Hall at Utrect. The Netherlands	70
4.14	Test well for ATES at an industrial site (ITT Flygt.	
	Emmaboda. Sweden)	71
4.15	Geothermal areas in Europe	71
4.16	Use of geothermal energy for heating purposes	72
4.17	Kimolos desalination unit	73
4.18	Location of geothermal DH sites in Europe	74
4.19	Total quantities and installed capacity of geothermal heat	
	pumps in the EU at the end of 2007 and at the end of 2008	79
4.20	Geothermal heat pump sales in Germany 1996–2008	83
4.21	Installed capacity for heating up to 2050	84
4.22	Heat production in Europe and EU-27 up to 2020	85
4.23	EGEC targets by 2050	86
5.1	Architecture of a wind turbine	94
5.2	How a wind turbine comes together	95
5.3	Winter: Windpark, Tarifa, Cadiz	96
5.4	European Wind Atlas, onshore 1989	97
5.5	European wind resources over open sea	98
5.6	Calculated costs per kWh wind-generated power as a function	0.0
	of the wind regime at the chosen site (number of full load hours)	101
5.7	Offshore wind power in the Oeresund Chanel Copenhagen 2008	102
5.8	Onshore and offshore wind power installed in Europe by	
-	end of 2007	104
5.9	Wind cannot be analysed in isolation from rest of the	
	power system	109
5.10	A high speed train rushing past wind turbines in France	111

5.11	18 years of global wind energy development 1991–2008	
	compared to the first 18 years of nuclear development	114
5.12	Leeming	114
6.1	Båstad Hotel, Båstad, Sweden	118
6.2	Daito Bunka University, Tokyo, Japan	118
6.3	Herne Hill school, UK	119
6.4	How a grid connected domestic system works	120
6.5	Lehrter Bahnhof, Berlin	121
6.6	Development of electricity prices and PV generation costs	124
6.7	Global cumulative PV power installed	125
6.8	Regional development of the global annual PV market	125
6.9	Global cell production 1999–2008	127
6.10	Cell production 2006–2008: Shares per region	127
6.11	Cell production in 2008: Shares per region	128
6.12	Cell production in 2008: Top 10 producers	129
6.13	Historical PV market development in Germany and EPIA	
	projections to 2013	133
6.14	Historical PV market development in Spain and EPIA	
	projections to 2013	134
6.15	Historical PV market development in Italy and EPIA	
	projections to 2013	135
6.16	Historical PV market development in France and EPIA	
	projections to 2013	136
6.17	Regional distribution of global and European annual PV	
	market in 2008	137
6.18	European annual PV market outlook until 2013	
	(policy-driven scenario)	138
6.19	Multicrystalline solar cell	139
7.1	Parabolic trough plant	143
7.2	Central Receiver Plant	144
7.3	Dish Stirling System	145
7.4	Linear Fresnel Collector	146
7.5	Estimated baseline sales price for Europe and MENA	
	(Middle East and North Africa)	147
7.6	Location of concentrating solar power plants in Spain	149
7.7	Power generation of solar thermal electricity plants in Europe	
	(TWh/year)	152
8.1	Conversion processes to bioenergy	153
8.2 and 8.3	Crop residues and animal manure for the production of a	
0.4	methane rich blogas	157
8.4	Spatial cost distribution for woody crops in 2005 (EGJ-1)	159
8.5	Overview of the development of the bioelectricity sector	
0.0	compared to other renewables up to 2007	162
8.6	Gross electricity production from biogas in the European	
0.7	Union in 2006 and 2007(GWN) Deliver in struments relevant d in EU and her states	163
8.7	Foncy instruments adopted in EU member states	166
8.8	riow much biopower:	168
9.1	Sman nyuro scheme – now it works	171
9.2	Setting of a Perton turbine	171

9.3	Pelton turbine	172
9.4	SHP capacity and future potential, 2006	179
9.5	VLH (eel-friendly turbine) in working position	185
9.6	Fish by-pass	187
9.7	Electricity generation 2000-2006 and forecast to 2010 for	
	SHP in EU-15 and EU-27	188
9.8	SHP potential	189
10.1	La Rance, St. Malo, France (240MW)	192
10.2	SeaGen, Marine Current Turbines, Strangford Lough,	
	Northern Ireland (1.2MW)	193
10.3	Enermar: Kobold turbines, Messina, Italy (prototype 40kW)	194
10.4	Pelamis, Agoucadoura wave farm, Portugal (2.25MW)	195
10.5	Wave Star, Nissum Bredning, Denmark (1:10 prototype, full	
	scale 6MW)	195
10.6	Wavebob, Galway Bay, Ireland, (1:4 prototype, full scale 2MW)	195
10.7	Limpet, Islay, UK (500kW)	196
10.8	Azores PICO plant, Portugal (500 kW)	196
10.9	Worldwide ocean energy projections: generated electricity	206
11.1	Temperatures within the earth	208
11.2	Larderello: Steam conduits through the valley	210
11.3	Larderello: Italian geothermal power plant	211
11.4	Geothermal power plant of Ribeira Grande, Azores, Portugal	212
11.5	Altheim CHP: Well-head and pump station	213
11.6	Summary of targeted costs	215
11.7	Unterhaching well testing	217
11.8	Soultz enhanced geothermal system (EGS) power plant	218
11.9	Soultz EGS power plant	219
11.10	Soultz EGS power plant	220
11.11	EGEC forecasts up to 2020	221
11.12	Trends up to 2030	222
12.1	Schematic diagram of production process of bioethanol and	
	DDGS from grains and sugar syrup	226
12.2	World ethanol production costs (\$/cubic metre)	229
12.3	EU bioethanol market (1993–2008)	230
12.4	Targets and actual achievement in the member states	233
13.1	Rapeseed field and biodiesel plant	239
13.2	Production of biodiesel (FAME)	240
13.3	Biodiesel plant	243
13.4	Evolution of the diesel demand in the EU	244
13.5	Global demand by product	244
13.6	OECD Europe diesel imports from FSU	245
13.7	EU biodiesel production capacity and biodiesel production	245
13.8	EU biodiesel industry today: Historical EU biodiesel production	246

TABLES

5 7 8
7
8
8
20) 8
9
9
toe) 10
sector
11
2030 22
40
42
45
1002
48
59
76
84
006) 99
102
103
123
132
132
134
135
136
158
160
ł
160
opean
161
ass
165
175
175
8 175
180
197

10.2	Support schemes in selected countries	205
10.3	Worldwide ocean energy projections: installed capacity	206
10.4	Worldwide ocean energy projections: generated electricity	206
11.1	Summary of targeted costs	215
11.2	Targets for EU-27	216
12.1	Different member states: Different support systems	232
13.1	EU 2006 and 2007 biodiesel production estimates	246
13.2	Quotas to be fulfilled by mineral oil companies in order to	
	reach their targets	248
13.3	Tax exemption for B100 and vegetable oils	249
13.4	Quotas for biofuel production set since 2004	250
13.5	TGAP rates	251

BOXES

2.1	Reaching the critical mass for economies of scale	23
2.2	Example: Qualisol scheme in France	29
2.3	The German market stimulation programme	32
2.4	Success story: Solar thermal in Upper Austria	33
2.5	Successful support through tax incentives in France	34
2.6	Spanish technical buildings code: Advanced solar legislation	35
2.7	A mature market but still with high potential	36
3.1	A new technology: The pellet condensing boiler	50
4.1	Best practices for FIS	80
6.1	Feed-in tariffs: Core elements	130
6.2	Efficiency targets for 2020	139