

Contents at a Glance

Introduction	1
Part 1: Here Comes the Sun	5
CHAPTER 1: Solar Power in Today's Energy Transition	7
CHAPTER 2: Understanding Your Energy Use	19
CHAPTER 3: Pondering How the Sun Powers Our World	35
Part 2: Investing in Residential Solar: Powering Your Home	49
CHAPTER 4: Deciding Whether Solar Power Is Right for Your Home	51
CHAPTER 5: Making Your Home More Energy Efficient	67
CHAPTER 6: Getting the Gist of How Installation Works	81
CHAPTER 7: Paying for Solar at Home	95
CHAPTER 8: Living with Solar	107
CHAPTER 9: Going off the Grid	117
Part 3: Examining Commercial and Industrial Solar Projects	133
CHAPTER 10: Seeing Why Businesses Go Solar	135
CHAPTER 11: Enhancing the Power System You Have	145
CHAPTER 12: Choosing Financing and Ownership Options	157
Part 4: Utility-Scale Solar: Powering the Grid	171
CHAPTER 13: Describing Solar Power at Utility-Scale	173
CHAPTER 14: Following the Journey of a Project	183
CHAPTER 15: Finding Out Who Buys the Power	199
Part 5: Seeing What's Next for Solar: The Future Is Bright	209
CHAPTER 16: Establishing Space-Based Solar Power	211
CHAPTER 17: Charging Batteries and Beyond: Storing the Sun	221
CHAPTER 18: The Future of Solar Cells	235
CHAPTER 19: Making Solar Smart with Software	247

Part 6: The Part of Tens	253
CHAPTER 20: Ten Smart Moves before Adopting Solar	255
CHAPTER 21: Ten of the Best Benefits of Going Solar	263
CHAPTER 22: Ten Misconceptions about Solar Power	271
Glossary	279
Index	285

Table of Contents

INTRODUCTION	1
About This Book	1
Foolish Assumptions	2
Icons Used in This Book	2
Beyond the Book	3
Where to Go from Here	3
 PART 1: HERE COMES THE SUN	 5
CHAPTER 1: Solar Power in Today's Energy Transition	7
Looking for Sustainable Energy	8
Understanding Why Solar Is King	8
Erasing your carbon footprint	8
Enjoying solar's unlimited supply	9
Embracing solar as the most affordable form of energy	10
Appreciating solar energy's versatility	11
Gaining independence from fossil fuels sources	11
Small to Supergiant: Solar Does It All	12
Residential projects	12
Commercial projects	14
Utility-scale projects	15
Acknowledging the Dents in the Crown	16
Regarding reliability and timing	16
Cutting the red tape (or not)	17
Land use and community concerns	18
 CHAPTER 2: Understanding Your Energy Use	 19
Dissecting Your Energy Bills	20
Checking out a sample electricity bill	21
Collecting the energy usage data	22
Divvying up costs, month by month	24
Gaining insight from your monthly data	25
Accounting for anomalies	26
Adding Up Typical Energy Usage at Home	28
Looking at averages across the United States	29
Relying on your specific energy use data	31
Interacting with Solar Power Beyond Your Home	32

CHAPTER 3:	Pondering How the Sun Powers Our World	35
	Exploring the Powerhouse in the Sky	36
	Acknowledging the origin and scope of available energy	36
	Solar radiation versus sunlight	37
	Finding out about photons	38
	Plotting Your Sun Charts	39
	Charting out the basic path of the Sun	39
	Noting sunlight intensity	41
	Recognizing Photovoltaic versus Thermal Solar	42
	Going from Photon to Power: How Solar Panels Work	44
	Types of solar technologies	44
	Anatomy of a PV system	46
	Looking at impacts on performance	47
	 PART 2: INVESTING IN RESIDENTIAL SOLAR: POWERING YOUR HOME	 49
CHAPTER 4:	Deciding Whether Solar Power Is Right for Your Home	51
	Recognizing the Benefits of Powering Your Home with PV Systems	52
	Determining System Size	53
	Figuring to offset (not zero out) your electricity costs	53
	Planning for future needs	54
	Comparing bids for your system	55
	Predicting System Production	55
	Considering panel efficiency	56
	Looking into inverter types	56
	Evaluating the tilt angle	57
	Facing the azimuth question	58
	Detecting shade levels	59
	Planning the distance from the roof	60
	Distinguishing DC and AC ratings	60
	Figuring expected energy output	61
	Making Quick Calculations on System Cost and Size	62
	Calculating cost savings on your electricity bill	63
	Putting the numbers together: Figuring payback	64
CHAPTER 5:	Making Your Home More Energy Efficient	67
	Knowing Why You Look to Energy Efficiency First	68
	Starting Inside the House	69
	Sheltering living spaces from the Sun	70
	Venting your attic and cooling off the entire house	71
	Providing an endless source of purified drinking water	72

Reading under the Sun at night.	73
Improving efficiency with everyday appliances	74
Moving to Outside the House	75
Lighting your yard with solar energy	75
Literally going green with landscaping.	76
Warming up the pool water with solar power.	77
Pumping water to new heights with a solar fountain	79
Getting creative with a solar-powered sprinkler.	80
CHAPTER 6: Getting the Gist of How Installation Works.	81
Paying Attention to Your Pocketbook.	82
Considering the Best Overall Investments	83
Getting the Most Out of Your Equipment	84
Starting with panel quality	85
Choosing an inverter wisely.	85
Connecting and monitoring your system	85
Installing a Photovoltaic System	86
Installing in a nutshell.	86
Deciding between a contractor or DIY	87
Working with kits.	88
Addressing the safety challenges	88
Being Realistic about Codes and Regulations.	89
On the honor system: Choosing to follow code	90
Passing code.	90
Hiring a Contractor	91
Knowing what a contractor can do.	91
Getting bids	91
Comparing bids	92
Interviewing a contractor	93
Committing to a contract	93
Working with a contractor	94
CHAPTER 7: Paying for Solar at Home.	95
The Different Types of Subsidies.	95
Looking for rebates.	96
Qualifying for tax credits	98
No property tax increases	98
Incentives for home-operated businesses	99
Net metering	99
Tax-deductible home equity loans	101
Researching All the Subsidy Options	102
Getting a Loan for Your Solar Power System	103
Borrowing money the old-fashioned way	104
Using an energy-efficient financing program	104

	Pursuing energy-efficient mortgages	105
	Thinking about other mortgage options	105
	Considering Alternative Financing and System Access	106
CHAPTER 8:	Living with Solar	107
	Monitoring System Performance	107
	Knowing what to watch for	108
	Warranty and performance guarantees	109
	Tracking Billing and Savings	110
	Performing Necessary Maintenance	112
	Keeping solar panels clean.	112
	Watching for shading and physical damage	112
	Scheduling inverter checkups	113
	Making an annual maintenance checklist	113
	Adding Storage or EV Charging	114
	Adding battery storage	114
	Charging your electric vehicle with solar power	115
CHAPTER 9:	Going off the Grid	117
	Understanding Off-Grid Ramifications	118
	When off-grid power systems make sense	118
	Taking accountability	119
	Considering higher upfront costs	120
	Noting the increased maintenance need.	121
	Looking green	121
	Surveying Off-Grid Solar Options	122
	Understanding Batteries and Power Storage	123
	Battery types	124
	Capacity and efficiency	124
	Maintaining batteries	125
	Battery lifetime expectations	126
	Risks involved with batteries	127
	Specifying and Pricing Your System	128
	Peeking In on a Real-Life Scenario	130
	PART 3: EXAMINING COMMERCIAL AND INDUSTRIAL SOLAR PROJECTS	133
CHAPTER 10:	Seeing Why Businesses Go Solar	135
	Making the Business Case for Generating Solar Energy	136
	Lowering operational costs	136
	Locking in energy prices	137
	Meeting equity, sustainability, and governance goals	138

Exploring Common Commercial and Industrial Use Cases.	139
Optimizing form and location	140
Addressing operational characteristics	141
Putting on the ESG showcase	141
Knowing What Makes a Good Solar Site Candidate	142
CHAPTER 11: Enhancing the Power System You Have	145
Adding Solar Capability to Your Property	146
Rooftop solar power systems	147
Parking lot solar installations.	148
Ground-mounted solar arrays.	150
Knowing What Factors to Consider.	151
What If You Don't Own the Building?	152
Structural Integrity and Practical Constraints	153
Thinking about Visibility and Branding Opportunities.	155
Advertising the decision to add solar power.	155
Identifying the business with green initiatives	155
CHAPTER 12: Choosing Financing and Ownership Options	157
Paying for Solar versus Leasing.	158
Considering outright ownership	158
Looking at leasing	158
Examining the differences	159
Using Tax Incentives for Business.	160
Making a Solar Option Happen	161
Modeling the impact of adding solar to your business	161
Getting buy-in from your organization.	163
Building Your System	164
Setting the groundwork for a solar project	164
Hiring an EPC	165
Comparing quotes from prospective partners.	166
Evaluating a project timeline	167
Commissioning your installed solar power system	168
PART 4: UTILITY-SCALE SOLAR: POWERING THE GRID	171
CHAPTER 13: Describing Solar Power at Utility-Scale	173
Defining Utility-Scale.	174
Acknowledging the Massive Impact of Utility-Scale Solar	175
Recognizing Ownership Models	176
Utility ownership	177
Independent power producer ownership	177
Ownership through institutional capital and infrastructure funds	178
Knowing Where You Find Utility-Scale Projects	178

Noting the Attributes of a Good Project	180
High available solar resource	180
Proximity to transmission infrastructure	181
Local compatibility and acceptance	182
CHAPTER 14: Following the Journey of a Project	183
Identifying the Main Player: The Developer	184
Living Through the Development Lifecycle	185
Land and site control	186
Permitting and local approvals	187
Environmental studies	189
Interconnection: The true hero	191
Community engagement	192
EPC selection and procurement	193
Addressing Financing and Capital Stack	194
Equity	195
Debt	195
Tax equity	195
Financial modeling and bankability	196
Operations and Maintenance at Utility Scale	196
Providing for Long-Term Asset Management and Revenue Optimization	198
CHAPTER 15: Finding Out Who Buys the Power	199
Understanding Power Purchase Agreements	200
Seeing the scope of power purchase agreements	200
Recognizing the unique elements	201
When agreements go virtual	202
Meeting the Power Buyers	202
Utilities: The original buyers	203
Large corporations: The emerging buyers	203
Community Choice Aggregators: The local buyers	204
Looking at Merchant Projects and Market Exposure	204
Seeing a merchant project at work	205
Planning for market exposure	205
Accommodating operational risks	206
Recognizing Solar Power Policy Drivers	206
Grasping Grid Integration and Curtailment	207
Managing grid integration	207
Dealing with curtailment	208

PART 5: SEEING WHAT'S NEXT FOR SOLAR: THE FUTURE IS BRIGHT	209
CHAPTER 16: Establishing Space-Based Solar Power	211
Describing Space-Based Solar Power.....	212
Reflecting sunlight to Earth with orbital mirrors.....	213
Turning sunlight into microwaves: Wireless power from space.....	214
Using infrared lasers to deliver energy to solar farms.....	216
Exposing the Impacts of Space-Based Systems on Solar Power.....	217
Significant operational factors.....	218
Effects on Earth-based solar infrastructure.....	218
Examining Barriers and Addressing Open Questions.....	219
The barriers.....	219
The questions.....	220
CHAPTER 17: Charging Batteries and Beyond: Storing the Sun	221
Seeing Why Storage Matters for Solar Power.....	222
Increasing the usefulness of solar power production.....	222
Enabling solar power at scale.....	223
Shifting supply to when it's needed.....	223
Smoothing intermittency and grid services.....	225
Exploring Types of Batteries.....	226
Lithium-ion battery technology.....	227
Iron flow battery technology.....	229
Sodium-based battery technology.....	230
Gravity storage technology.....	231
Green hydrogen technology.....	232
Compressed air technology.....	233
Thermal battery technology.....	234
CHAPTER 18: The Future of Solar Cells	235
Recycling Solar Panels.....	236
Recycling now and looking ahead.....	236
Recycling that's sustainable and built-in.....	236
Maximizing Panel Efficiency.....	237
Components of efficiency.....	237
Perovskite solar cells.....	238
Heterojunction solar cells.....	240
Tunnel oxide passivated contact.....	241
Tandem cells.....	242
Decreasing Costs.....	244

CHAPTER 19: Making Solar Smart with Software	247
Designing and Optimizing the Best System	248
Combining digital tools for system design	248
Pulling in historical data for optimization	249
Operations & Maintenance Software	249
Energy Management Systems and Smart Home Integration	250
Simplifying solar power with EMS	251
Using EMS at home or for an office	251
Creating advantages for the grid	251
PART 6: THE PART OF TENS	253
CHAPTER 20: Ten Smart Moves before Adopting Solar	255
Get a Firm Grasp on Your Current Energy Usage	255
Improve Efficiency First to Reduce System Size and Cost	256
Understand Your Utility Rate Structure	257
Identify Tax Credits and Rebates	257
Get Multiple Bids from Vetted Contractors	258
Assess Site Readiness and Conditions	259
Forecast Future Energy Needs	259
Know How You Need to Connect to the Grid	260
Make Sure to Map Permits, Approvals, and Inspections	260
Figure Your Payback Horizon and Risks	261
CHAPTER 21: Ten of the Best Benefits of Going Solar	263
Lower Electricity Costs	263
Energy Price Stability	264
Tax Incentives and Rebates	264
Carbon Emissions Reduction	265
Boosted Property and Asset Value	266
Energy Independence	266
Improvements in ESG Scores and Public Perception	267
Job Creation and Local Economic Growth	268
Silent and Low-Maintenance Operation	268
Modularity and Scalability	269
CHAPTER 22: Ten Misconceptions about Solar Power	271
Solar Power Only Works When the Sun Is Shining	272
You Need to Live in a Hot, Sunny Climate for Solar to Be Worth It	272
Solar Panels Require Constant Maintenance or No Maintenance at All	273
Solar Power Is Expensive	274

Installing Solar Power Means You're Off-Grid	274
Solar Power Doesn't Work in the Winter or Snow	275
Panels Are Bad for the Environment	275
Solar Can't Power Large Infrastructure or Industry	276
There's Not Enough Land for All the Solar Power We Need	276
Solar Power Is Just a Fad	277
GLOSSARY	279
INDEX.....	285

