

Contents

Acknowledgements.....vi
Introduction.....vii

Chapter 1: Facing the Sun

How to Get More Solar Energy All Year Long 12
Earth's Poles, The Equator, Northern & Southern Hemispheres, Day & Night
The Reasons for the Seasons 13
The Earth's axis is tilted, Earth's Orbit, Solstices & Equinoxes
Why Is It Colder In Winter?..... 14
The Sun's Arc, Energy & Sun Angles
There are Two North Poles 15
True North & Magnetic North, Magnetic Declination Maps

Chapter 2: Understanding Heat

What Happens When an Object Gets Hot?..... 20
Heat is a form of energy: the energy of atoms in motion, Atoms & Molecules
Hot Objects Expand
Radiation, Convection & Conduction 21
Light & Heat, Radiation & Heat Transfer, Colors & Heat, Conduction in Solids,
Convection in Liquids, Air Acts Like a Liquid
Insulation Blocks Heat Flow 24
Stationary Air Acts as an Insulator 25

Chapter 3: Solar Ovens

How to Cook Food With The Sun 30
The Greenhouse Effect, A Solar Box Cooker
Principles of Solar Cooking 31
Bring in Sunlight, Absorb the Heat, Keep the Heat
Solar History: Solar Cooking 32

Chapter 4: Solar Hot Water

Heating Water With Sunlight	36
<i>Standard Water Heaters, Solar Batch Heaters</i>	
Solar Collectors	37
<i>Solar for Swimming Pools, Flat Plate Collectors</i>	
Using Solar Collectors	38
<i>Thermosiphon Systems, Drainback Systems</i>	
Tankless Water Heaters.....	40
<i>Heat Exchangers, Solar Preheat</i>	
Solar History: Solar Water Heating.....	41

Chapter 5: Passive Solar Design

How to Stay Comfortable All Year Long	48
House Location & Position	48
<i>Seasonal Shading, Wind Blocks, Trees & Hills</i>	
South Facing Windows	49
<i>Windows & Heat Loss</i>	
Insulation & Thermal Mass.....	50
<i>Direct Gain Systems, Sunspaces, Trombe Walls, Day & Night Heating</i>	
Convection Currents & Cooling	53
<i>Nighttime cooling, Daytime cooling, Earth cooling</i>	
Daylighting.....	54
<i>Overhangs, Curtains & Blinds, Skylights, Shading, Clerestories</i>	
Solar History: Solar Design	57

Chapter 6: Solar Electricity

Making Electricity with Photovoltaics.....	64
<i>Photons, Electrons, Protons, Electrical Charges</i>	
The Photovoltaic Effect.....	65
<i>Solar cells, Modules & Arrays, Sun Angles, Tilt Angles, Shadows</i>	
Basic Electrical Circuits	68
<i>Elements of electrical circuits, Volts, Amps, Watts</i>	
Increasing Power	70
<i>Series & Parallel Wiring, The Power Formula</i>	
Using Solar Electricity	72
<i>PV direct systems, Battery backup systems, DC & AC, Inverters, Utility Intertie</i>	
Solar History: Photovoltaics.....	75

Chapter 7: System Sizing

How Much Energy Do You Need?	84
<i>Using Energy Efficiently, Energy Guide Label, Phantom Loads & Vampires</i>	
Energy Audits	88
<i>Measuring Electricity Use, Rate of Energy Use, Watts & Kilowatts, Total Energy Used, Watt-Hours and Kilowatt Hours</i>	
Auditing Loads.....	90
<i>Hours of Use, Electric Bills</i>	
Electric meters	92
Array sizing	94
<i>Peak Sun, Peak Sun Hours, Peak Sun Hours per Day, Module Output,</i>	
System Sizing Worksheet	96
Projects.....	99
Glossary	123
Index.....	127