

INDUSTRY PRIMER: SOLAR ENERGY

AUGUST 2010

MAX PRILUTSKY

RESEARCH ANALYST

P: (646) 395-9690 | F: (419) 818-9158 | E: MAX@INDUSTRYPRIMERS.COM

Table of Contents

EXECUTIVE SUMMARY	6
INTRODUCTION	8
INDUSTRY OVERVIEW	8
BRIEF HISTORY OF THE INDUSTRY	8
TAXONOMY OF SOLAR TECHNOLOGIES	10
INDUSTRY COMPOSITION	21
SOLAR INDUSTRY SUBSECTORS	21
INDUSTRY VALUE CHAIN	21
INDUSTRY FRAGMENTATION	23
INDUSTRY SIZE	24
SIZING METHODOLOGY	24
ESTIMATED INDUSTRY SIZE	26
INDUSTRY BREAKDOWN BY SUBSECTOR AND VALUE CHAIN.....	27
INDUSTRY BREAKDOWN BY GEOGRAPHY	30
INDUSTRY GROWTH	35
HISTORICAL GROWTH.....	35
FORECAST AND DRIVERS	37
INDUSTRY TRENDS AND THEMES	41
GROWTH OF OVERALL RENEWABLE ENERGY MARKET	41
COMPLEX AND UNCERTAIN REGULATORY LANDSCAPE.....	41
EFFECTS OF THE GLOBAL CREDIT CRISIS.....	42
PRICE AND COST REDUCTIONS OF PV SYSTEMS	42
RESHAPING OF THE SILICON SUPPLY MODEL.....	47
UNDERSTANDING GRID PARITY	47
CUTTING EDGE TECHNOLOGICAL INNOVATIONS.....	53
STRATEGIC ANALYSIS	56
FIVE FORCES ANALYSIS	56
SWOT ANALYSIS.....	59
CUSTOMER SEGMENTS	62
REGULATORY MATTERS	65
OVERVIEW OF REGULATORY STRUCTURES	65
GLOBAL REGULATORY LANDSCAPE	67
REGULATORY TRENDS TO WATCH.....	71
INVESTMENT RISKS AND MITIGANTS	74

- DISCUSSION OF INDUSTRY RISK FACTORS 74
- OBSOLESCENCE RISK AMONG COMPETING TECHNOLOGIES..... 76
- DILIGENCE QUESTIONS FOR POTENTIAL INVESTMENTS..... 78
- FINANCIAL ANALYSIS..... 81**
 - REVENUE GROWTH OF PUBLICLY TRADED COMPANIES 81
 - PROFITABILITY OF PUBLICLY TRADED COMPANIES 81
 - PUBLIC COMPARABLES VALUATION 82
 - HISTORICAL VALUATION TRENDS..... 85
 - ANALYSIS OF M&A TRANSACTIONS 85
 - ANALYSIS OF VENTURE CAPITAL ACTIVITY..... 90
- KEY PLAYERS 92**
 - COMPANY PROFILES 92
 - INVESTMENT FIRMS ACTIVE IN THE SOLAR INDUSTRY 110
- USEFUL RESOURCES FOR FURTHER RESEARCH 119**

Table of Exhibits

Exhibit 1 – Photographs of Solar Technologies.....	10
Exhibit 2 – Photographs of Solar-Thermal Concentrating Technologies.....	15
Exhibit 3 – Summary of Emerging CSP Technologies	17
Exhibit 4 – Parts and Components of Solar Energy Technology.....	17
Exhibit 5 – Photographs of Solar Consumer Products, Appliances and Accessories	18
Exhibit 6 – Summary of Solar Technology Taxonomy.....	20
Exhibit 7 – Solar Energy Industry Sub-segment Map.....	21
Exhibit 8 – Solar Energy Industry Value Chain	22
Exhibit 9 – Methods of Calculating Solar Industry Size	25
Exhibit 10 – Solar Industry Size by Sub-Sector.....	26
Exhibit 11 – 2009 Solar Industry Size Estimates by Sub-Sector and Value Chain.....	27
Exhibit 12 – Build-up of Global PV (Solar-Electric) Industry Size by Value Chain, 2009	28
Exhibit 13 – Build-up of Global ST (Solar-Thermal) Industry Size by Value Chain, 2009.....	29
Exhibit 14 – PV Installation Market Shares by Country, 2007-2009	30
Exhibit 15 – CST Power Plant Installations in 2009.....	31
Exhibit 16 – CST Market Shares by Country, 2009.....	32
Exhibit 17 – Summary of SEGS Facilities.....	32
Exhibit 18 – Market Share by Country: ST Heating Installed Capacity, 2009.....	33
Exhibit 19 – Market Share of Installations by Country: 2007, 2008 and 2009 (GWth).....	34
Exhibit 20 – Historical Growth of the Global PV Market (1999-2009).....	35
Exhibit 21 – Historical Growth of the Global CST Market (1999-2009)	36
Exhibit 22 – Historical Growth of the Global Solar Heater Market (1999-2009).....	36
Exhibit 23 – Total Solar Energy Industry Growth Forecast.....	37
Exhibit 24 – Photovoltaic Market Detailed Forecast, 2009-2014.....	38
Exhibit 25 – Solar Thermal Heater Market Detailed Forecast, 2009-2014	39
Exhibit 26 – Concentrated Solar-Thermal Market Detailed Forecast, 2009-2014.....	40
Exhibit 27 – Monthly Change in PV Module Prices, 2007-2010	43
Exhibit 28 – Record Photovoltaic Efficiency Levels Over Time	45
Exhibit 29 – Illustrative Cost Savings Opportunities Across the Solar Value Chain.....	46
Exhibit 30 – PV Operating Leverage: Overhead Costs by System Size.....	46
Exhibit 31 – Factors Influencing Grid Parity.....	48
Exhibit 32 – Competing Sources of Energy.....	49
Exhibit 33 – Factors Influencing Long-Term Potential of Alternative Energy Sources.....	50
Exhibit 34 – Comparison of Competing Renewable and Non-Renewable Energy Sources.....	51
Exhibit 35 – Map of Earth’s Exergy Flows	53
Exhibit 36 – Solar Energy Industry Five Forces Analysis, Manufacturers	57
Exhibit 37 – Solar Energy Industry Five Forces Analysis, Value Added Distributors.....	58
Exhibit 38 – Solar Energy Industry Five Forces Analysis, Retailers & Installers	58
Exhibit 39 – U.S. Shipment Volume of Photovoltaic Cells and Modules, 2008	64
Exhibit 40 – U.S. Shipment Volume of Solar-Thermal Collectors, 2008.....	64
Exhibit 41 – Overview of the Types of Incentives and Regulations	65
Exhibit 42 – Four Types of Government Influence on the Solar Industry.....	66

Exhibit 43 – Summary of Subsidies, Incentives, Regulations and Other Drivers By Country	68
Exhibit 44 – Summary Map of U.S. State Regulations and Incentives	70
Exhibit 45 – Indexed Price Performance of Solar Stocks Versus Crude Oil Prices	75
Exhibit 46 – Solar Technology Obsolescence Risk Framework	76
Exhibit 47 – Sample Due Diligence Questions for Solar Companies	78
Exhibit 48 – Average Revenue Growth by Value Chain, 2005-2009	81
Exhibit 49 – Average Gross Margin by Value Chain, 2005-2009	82
Exhibit 50 – Average EBITDA Margin by Value Chain, 2005-2009	82
Exhibit 51 – Public Comparables Analysis by Value Chain	83
Exhibit 52 – Indexed Stock Price Performance by Solar Industry Value Chain, 2008-2010	85
Exhibit 53 – Completed Solar Energy Transactions, 2005-2009	86
Exhibit 54 – Selected Solar Industry M&A Transactions	88
Exhibit 55 – Global Cleantech VC Volume & Deals by Year, 2005 - 2009	90
Exhibit 56 – Global Cleantech VC Volume & Deals by Sector, 2009	91
Exhibit 57 – Industry Associations	119
Exhibit 58 – Relevant Websites	119
Exhibit 59 – Conferences & Industry Events	119
Exhibit 60 – Industry Reports	120
Exhibit 61 – Ongoing Publications	120

Executive Summary

There was a time not long ago when the idea of a world powered by solar energy was purely science fiction. Today, however, solar energy products and services amount to an \$85 billion industry. It is comprised of over 7,500 for-profit companies spanning most countries of the world and is backed by investments from venture capital funds, private equity firms and the public markets. The industry encompasses materials producers, manufacturers, distributors, retailers, installers and service providers.

With governments increasingly subsidizing the price of clean energy and venture capital firms backing the push for innovation in solar panel efficiency, the cost of solar energy generation is decreasing rapidly. In addition, solar panel efficiency has approximately doubled over the past decade, while costs have been cut in half. Technological innovations also have allowed solar panels to become integrated into building structures, printed on flexible materials, optimized with advanced sun-tracking algorithms and concentrated many times over by large fields of reflective panels.

At the current rate of innovation, it is not surprising that investors are no longer sitting on the sidelines. In 2009, solar companies received more venture capital funding than any other segment of cleantech, in terms of both dollar value funded and number of deals closed. Solar M&A deal activity was up nearly 100% year-over-year in 2009, and deal flow has remained strong since the recent economic downturn rationalized public market valuations of solar energy companies.

However, there are still drawbacks to solar energy adoption—in most circumstances, the relative price of generating electricity with solar is still not at ‘grid parity’ with fossil fuels such as coal, petroleum and crude oil. As a result, investing in solar energy companies remains a relatively “high-risk, high-reward” strategy. For every solar energy company, the drivers of success may differ across technologies, market segments and geographies, posing a variety of risks and opportunities for investors. Therefore, an understanding of the solar products and services landscape, in light of regulatory and competitive influences, is a fundamental requisite for making informed investment decisions. This report intends to help potential investors more effectively navigate this complex landscape.

In This Report

This report presents a comprehensive overview and analysis of the solar energy industry, with an emphasis on answering questions that finance and investment professionals may have while evaluating companies in the industry.

The report begins with a detailed explanation of the types of products and services that make up the industry, including:

- Technology types: Solar-electric, solar-thermal and combined
- Panel applications: Distributed and concentrating
- End-markets: Residential, commercial, industrial and utilities
- Value chain segments: Raw materials, ingots/wafers, cell and module manufacturers, value added distributors, retailers, installers and services providers

The 'Industry Composition' section provides a breakdown of the solar market in terms of product groups, value chain segments and customer end-markets. Next, the report provides industry sizing estimates, historical growth trends and a detailed forecast for industry growth through 2014. It also offers modeling guidance that readers will find useful for building independent industry forecasts and evaluating third party estimates. The following section describes the most relevant overarching concepts for evaluating the industry, including frameworks for analyzing the competition with other renewable energy sources, the effect of government regulation on the industry, a review of promising new technological innovations and the effect of the recent economic downturn on the industry. The next section applies widely used strategy frameworks to analyze competition in the industry and help identify strategic opportunities for investors. Next, a detailed overview of regulatory matters illustrates the complexity of varying government policies that impact solar companies around the world. The report then identifies key risks of investing in the solar industry, suggests mitigation strategies and provides a list of diligence questions for buy-side professionals to use in evaluating potential targets. A section on financial analysis compares public company financials, illustrates historical trends and analyzes valuations across the solar industry value chain. The final segment of the report offers short profiles of 120 companies and investment firms that are active in the solar industry, as well as a list of over 50 useful resources for additional research such as relevant industry associations, other industry reports, upcoming conferences and informative websites.