

CHAPTER ONE: INTRODUCTION.....	1
STUDY GOALS AND OBJECTIVES.....	1
REASONS FOR DOING THE STUDY	1
INTENDED AUDIENCE.....	1
SCOPE OF REPORT	2
METHODOLOGY	2
INFORMATION SOURCES.....	2
ANALYST CREDENTIALS.....	3
RELATED BCC WORK CREDENTIALS	3
BCC ONLINE SERVICES.....	3
DISCLAIMER	3
 CHAPTER TWO: SUMMARY.....	 4
SUMMARY.....	4
<i>SUMMARY TABLE GLOBAL MARKET FORECAST FOR HIGH-</i> <i>BRIGHTNESS LEDS, BY INDUSTRY, THROUGH 2014 (\$</i> <i>MILLIONS)</i>	 5
<i>SUMMARY FIGURE VALUE OF GLOBAL LED SHIPMENTS BY</i> <i>INDUSTRY, 2008-2014 (\$ MILLIONS)</i>	 5
 CHAPTER THREE: OVERVIEW OF THE CURRENT SOLID-STATE	
LIGHTING ENVIRONMENT.....	6
SCOPE OF LIGHTING.....	6
GLOBAL LIGHTING PERSPECTIVE.....	7
<i>TABLE 1 ESTIMATED GLOBAL CONSUMPTION OF ENERGY, 2008</i> <i>(QUADS)</i>	 7
CURRENT LIGHTING SYSTEMS	8
<i>TABLE 2 EFFICACIES OF CURRENT LIGHTING SYSTEMS (LUMENS</i> <i>PER WATT)</i>	 9
THE IMPORTANCE OF LED LIGHTING.....	9
<i>TABLE 3 OVERALL BENEFITS OF SOLID-STATE LIGHTING</i>	 10
APPLICATIONS OF SOLID-STATE LIGHTING	10
<i>TABLE 4 GENERAL APPLICATIONS OF SOLID-STATE LEDS</i>	 11
SUBSTRATES INCLUDED IN LED VALUE	11
 CHAPTER FOUR: INDUSTRY STRUCTURE	 12
INDUSTRY STRUCTURE	12
<i>TABLE 5 LEADING COMPANIES IN THE LED SOLID-STATE</i> <i>LIGHTING INDUSTRY</i>	 13
<i>TABLE 5 (CONTINUED)</i>	14
GLOBAL MANUFACTURING OBSERVATIONS.....	15
REGIONAL DISTRIBUTION OF LED MANUFACTURING	15
<i>TABLE 6 ESTIMATED GLOBAL PRODUCTION OF LEDS FOR SOLID-</i> <i>STATE LIGHTING APPLICATIONS, BY REGION, 2008-2014</i>	 16

<i>FIGURE 1 GLOBAL PRODUCTION OF LEDS BY REGION 2008-2014</i>	
(%).....	16
REGIONAL CONSUMPTION OF LEDS	17
<i>TABLE 7 GLOBAL CONSUMPTION OF SOLID-STATE LEDS BY</i>	
<i>REGION, 2008-2014 (%).....</i>	17
<i>FIGURE 2 GLOBAL CONSUMPTION OF LEDS BY REGION, 2008-2014</i>	
(%).....	18
MARKET SHARES.....	19
<i>TABLE 8 HIGH-BRIGHTNESS GLOBAL LED MAKERS BY GLOBAL</i>	
<i>MARKET SHARE (%).....</i>	19
COMPANY PROFILES	20
AVAGO TECHNOLOGIES	20
CREE INC.	20
DIALIGHT CORPORATION	21
D-LED ILLUMINATION TECHNOLOGIES.....	22
EPISTAR CORPORATION.....	22
GE LUMINATION	23
INTERNATIONAL LIGHT TECHNOLOGIES	23
NICHIA CORPORATION.....	24
OPTOTECH CORPORATION.....	24
OSRAM OPTO SEMICONDUCTORS.....	25
PERKINELMER	26
PHILIPS LUMILEDS	26
PHILIPS COLOR KINETICS.....	27
SAMSUNG LED.....	28
SIGNCOMPLEX.....	28
SEIKO-EPSON.....	29
STANLEY ELECTRIC.....	29
SUNLED CORPORATION USA	30
TT OPTEK TECHNOLOGY	30
VEECO INSTRUMENTS.....	31
CHAPTER FIVE: LED TECHNOLOGY.....	32
BASIC LED TECHNOLOGY.....	32
<i>TABLE 9 BASIC STRUCTURE OF A LIGHT-EMITTING DIODE.....</i>	33
SEMICONDUCTOR LIGHT-EMITTING DIODES.....	33
HOW LEDS WORK.....	33
COMMON LED TYPES AND PACKAGES	34
<i>TABLE 10 BASIC LED TYPES AND PACKAGES</i>	34
COLOR QUALITY.....	34
Light and Color Basics	35
Correlated Color Temperature.....	35
The Color Rendering Index	36
Getting LEDs to Emit Color.....	36

<i>TABLE 11 KEY MATERIAL TECHNOLOGIES FOR PRODUCING COLOR IN LEDS.....</i>	<i>36</i>
HIGH-BRIGHTNESS LEDS	37
BACKGROUND	37
<i>TABLE 12 COMPARISON OF TRADITIONAL AND HIGH- BRIGHTNESS LEDS.....</i>	<i>38</i>
MAKING WHITE LIGHT WITH LEDS.....	38
<i>TABLE 13 COMPARISON OF WHITE LIGHT LED TECHNOLOGIES</i>	<i>39</i>
SUBSTRATE CONSIDERATIONS.....	40
<i>TABLE 14 CHARACTERISTICS OF TWO POPULAR HIGH- BRIGHTNESS LED SUBSTRATES</i>	<i>41</i>
LED FABRICATION	41
TRADITIONAL INDICATOR LED	42
<i>TABLE 15 SCHEMATIC OF A TYPICAL INDICATOR LAMP</i>	<i>42</i>
HIGH-BRIGHTNESS LED	42
<i>TABLE 16 SCHEMATIC OF A HIGH-BRIGHTNESS LED.....</i>	<i>42</i>
FABRICATION PROCESSES	43
Metal Organic CVD	43
<i>TABLE 17 KEY TECHNICAL ADVANTAGES OF MOCVD</i>	<i>44</i>
Molecular Beam Epitaxy	44
<i>TABLE 18 KEY TECHNICAL FEATURES OF MBE</i>	<i>45</i>
Vapor Phase Epitaxy	45
Liquid Phase Epitaxy	46
CURRENT FABRICATION METHODS.....	46
<i>TABLE 19 PREFERRED LED FABRICATION PROCESS, 2009 (%)</i>	<i>47</i>
<i>FIGURE 3 PREFERRED LED FABRICATION METHODS, 2009 (%)</i>	<i>47</i>
ORGANIC LIGHT-EMITTING DIODES.....	47
LED TECHNOLOGY TRENDS.....	48
TRADITIONAL LIGHTING TECHNOLOGIES	48
<i>TABLE 20 MAJOR ISSUES IN STANDARD LIGHTING</i>	<i>48</i>
SOLID-STATE LED LIGHTING	49
LED LIGHTING PATENT ANALYSIS	50
SCOPE OF PATENT ACTIVITY.....	50
OUR LOOK AT LED PATENTS.....	50
PATENTS BY TECHNICAL SUBJECT	50
<i>TABLE 21 LED LIGHTING PATENTS BY TECHNICAL CATEGORY LATE 2007, 2008, AND EARLY 2009.....</i>	<i>51</i>
PATENTS BY COMPANY	51
<i>TABLE 22 LED LIGHTING PATENTS BY COMPANY LATE 2007, 2008, EARLY 2009.....</i>	<i>52</i>
SAMPLE PATENT ABSTRACTS.....	53
LEDs Include Transparent Oxide Layers	53
Light-Emitting Diode Package Structure.....	53

Light-Emitting Diode Module, Backlight Assembly, and Display Device Having the Same	54
LED with Substrate Modifications for Enhanced Light Extraction	54
Laser Patterning of Light-Emitting Devices	55
Compact Optical Engine for Small Personal Projectors Using LED Illumination	55
Water Purification Systems Uses UV Light-Emitting Diodes	56
Making LEDs with Improved Light Extraction by Roughening.....	56
Vehicle Lighting Methods and Apparatus.....	57
CHAPTER SIX: INDUSTRY COMPETITIVENESS.....	58
U.S. GOVERNMENT/INDUSTRY SUPPORT	58
DOE SSL R&D MULTI-YEAR PLAN	58
<i>TABLE 23 CURRENT LIGHT-EMITTING DIODE PROJECTS</i>	59
THE CALIPER PROGRAM	59
ENERGY STAR PROGRAM FOR SOLID-STATE LIGHTING	60
SSL QUALITY ADVOCATES.....	60
INDUSTRY-RELATED SUPPORT	61
The Optoelectronic Industry Development Association (OIDA).....	61
<i>TABLE 24 COMMUNITIES OF INTEREST FORMED BY OIDA</i>	61
The Next Generation Lighting Industry Alliance (NGLIA)	62
EUROPEAN GOVERNMENT/INDUSTRY SUPPORT	62
EUROPEAN PHOTONICS INDUSTRY CONSORTIUM	62
<i>TABLE 25 THE EPIC NETWORK</i>	63
PLANS FOR THE FUTURE.....	63
ASIA-PACIFIC ACTIVITY	64
JAPAN	64
Japanese Companies Make Progress in Solid-State Lighting	64
Some Planned Development Work.....	64
<i>TABLE 26 LED DEVELOPMENT PROJECTS IN JAPAN</i>	65
KOREA	65
CHINA	65
<i>TABLE 27 MARKET SHARE OF LED APPLICATIONS IN CHINA, 2008</i> (%).....	66
China's Plan.....	66
THE GLOBAL ECONOMIC CRISIS	67
CURRENT SITUATION	67
Drop in GDP and Falling Consumer Sales.....	67
<i>TABLE 28 SECOND QUARTER 2009 ECONOMIC MILESTONES</i>	68
<i>TABLE 29 ECONOMIC FACTORS IMPACTING THE LED INDUSTRY</i>	69

Impact on Current Demand	69
Current Consensus on the Technology Industry	69
What the Economists Think	70
Long-Term Look at the Economy	70
<i>TABLE 30 ECONOMIC ASSUMPTIONS FOR THE GROWTH OF LEDS</i>	71
LED STANDARDS DEVELOPMENT	71
NEW STANDARDS RELEASED IN 2008	71
STANDARDS IN DEVELOPMENT	72
<i>TABLE 31 LED STANDARDS IN DEVELOPMENT, 2009</i>	72
MARKET GROWTH FACTORS	72
Driving Forces for Growth	73
Impact of Market Growth Factors	74
<i>TABLE 32 IMPACT OF KEY COMPETITIVENESS FACTORS ON THE</i> <i>GROWTH OF THE LED LIGHTING INDUSTRY (%)</i>	74
<i>FIGURE 4 KEY COMPETITIVENESS FACTORS ON THE GROWTH OF</i> <i>THE LED LIGHTING INDUSTRY (%)</i>	74
CHAPTER SEVEN: THE LED LIGHTING MARKET	75
MARKET APPROACH	75
MARKET PERSPECTIVE	75
<i>TABLE 33 ESTIMATED GLOBAL LED LIGHTING REVENUES AND</i> <i>MARKET SHARE, 2008 (\$ MILLIONS / SHARE %)</i>	75
<i>FIGURE 5 ESTIMATED GLOBAL REVENUES OF LEDS FOR</i> <i>LIGHTING, 2008 (\$ MILLIONS)</i>	76
MARKET ANALYSIS	77
MEASUREMENT OBJECTIVES	77
CHAPTER EIGHT: THE AUTOMOTIVE LED MARKET	78
MARKET SCOPE	78
LAMP USAGE IN AUTOS	79
AUTOMOTIVE INDUSTRY LED APPLICATIONS	80
MAJOR USES OF LEDS	80
<i>TABLE 34 MAJOR LED APPLICATIONS FOR AUTOMOBILES</i>	80
<i>TABLE 34 (CONTINUED)</i>	81
EXTERIOR LIGHTING	81
The CHMSL Light System	81
<i>TABLE 35 COST SAVINGS FOR AUTOMOTIVE CENTER HEAD-</i> <i>MOUNTED STOP LIGHTS</i>	82
Impact of Materials	82
The Snap LED System	83
Luxeon LEDs Provide Exterior Headlamps	83
INTERIOR LIGHTING	84
<i>TABLE 36 BENEFITS OF USING LEDS IN AUTO INTERIOR</i> <i>LIGHTING</i>	84
<i>TABLE 37 AUTOMOTIVE LED TECHNICAL AND SAFETY FEATURES</i>	85

MAJOR ADVANTAGES OF LEDS IN THE AUTOMOTIVE INDUSTRY	86
MAINTENANCE COSTS ARE REDUCED	86
INCREASED VEHICLE OPERATING SAFETY	86
LED in CHMSL Important for Safety	87
<i>TABLE 38 LED SAFETY ADVANTAGES FOR AUTOS</i>	87
SATURATED COLORS, WITHOUT FILTERS	87
REDUCED POWER CONSUMPTION	87
<i>TABLE 39 ESTIMATED COST AND WEIGHT SAVINGS PER SIGNAL LAMP FROM USE OF A SMALLER ALTERNATOR</i>	88
ENVIRONMENTAL ADVANTAGES.....	88
DESIGN FLEXIBILITY	89
LED AUTOMOTIVE LAMPS	89
<i>TABLE 40 SAMPLE CONFIGURATIONS OF AUTOMOTIVE LEDS</i>	90
OPTICAL AND THERMAL DESIGN	90
FLEXIBLE PACKAGING	91
Interior Lighting.....	91
MARKET ASSESSMENT.....	91
POSITIVE FACTORS	91
PROBLEMS WITH SALES OF AUTOMOBILES	92
Recent Automotive Growth Trends	92
<i>TABLE 41 GLOBAL GROWTH TREND FOR AUTOMOBILES, THROUGH 2008 (MILLION UNITS)</i>	92
INCREASED DEMAND FOR LEDS.....	93
<i>TABLE 42 LED MARKET PENETRATION IN THE GLOBAL AUTOMOTIVE MARKET, THROUGH 2008 (MILLION UNITS)</i>	93
IMPACT OF ECONOMIC CRISIS ON AUTOS AND LEDS	93
Some Hope in Other Regions	94
LEDs are Part of the Package.....	94
Our Outlook for the Auto Industry and LEDs	94
FORECAST ASSUMPTIONS—LEDS IN AUTOMOTIVE APPLICATIONS	95
<i>TABLE 43 FORECAST ASSUMPTIONS—GROWTH OF LEDS IN THE AUTOMOTIVE INDUSTRY</i>	95
<i>TABLE 44 GLOBAL MARKET FORECAST FOR LED GROWTH IN THE AUTOMOTIVE INDUSTRY, THROUGH 2014 (MILLION UNITS/%)</i>	95
FORECAST—SHIPMENTS OF LEDS FOR AUTOMOTIVE APPLICATIONS	96
<i>TABLE 45 AVERAGE NUMBER OF HB-LEDS IN VEHICLES AND THEIR AVERAGE COSTS, 2008-2014</i>	96
<i>TABLE 46 FORECAST—GLOBAL LED SHIPMENTS FOR THE AUTOMOTIVE INDUSTRY, THROUGH 2014 (MILLION UNITS)</i>	97
FORECAST—VALUE OF LED SHIPMENTS.....	97

<i>TABLE 47 VALUE OF GLOBAL LED SHIPMENTS FOR THE AUTOMOTIVE INDUSTRY, THROUGH 2014 (\$ MILLIONS)</i>	97
<i>FIGURE 6 GLOBAL VALUE OF LED SHIPMENTS FOR THE AUTOMOTIVE INDUSTRY, 2008-2014 (\$ MILLIONS)</i>	98
FORECAST—SHIPMENTS OF INDIVIDUAL LEDS	98
<i>TABLE 48 FORECAST—INDIVIDUAL LEDS USED IN THE AUTOMOTIVE MARKET, THROUGH 2014 (MILLION UNITS)</i>	99
FORECAST—USE OF SUBSTRATE MATERIALS	99
<i>TABLE 49 GLOBAL USE OF LED SUBSTRATE MATERIALS FOR AUTOMOTIVE APPLICATIONS, 2008-2014 (%)</i>	100
 CHAPTER NINE: DISPLAY BACKLIGHTING	101
MARKET SCOPE.....	101
LAMP USAGE IN BACKLIGHTING	102
<i>TABLE 50 SCOPE OF THE LED BACKLIGHTING MARKET</i>	102
LED APPLICATIONS IN BACKLIGHTING.....	103
BACKGROUND AND TECHNICAL DEVELOPMENTS	103
<i>TABLE 51 BENCHMARKS IN LEDS FOR DISPLAY BACKLIGHTING</i>	103
<i>TABLE 52 LED BACKLIGHTING APPLICATIONS</i>	104
KEY ADVANTAGES OF LED BACKLIGHTING	105
HIGH-PERFORMANCE LCD BACKLIGHTING.....	105
<i>TABLE 53 LINEAR LIGHT OUTPUT FROM LEDS AND A CCFL LAMP</i>	105
REDUCED POWER CONSUMPTION	106
BETTER COLOR PERFORMANCE	106
THIN FORM FACTOR FOR THE FUTURE EXPANDS MARKET	106
<i>TABLE 54 SUMMARY OF LED BACKLIGHTING ADVANTAGES</i>	107
CURRENT LED BACKLIGHTING LAMPS.....	107
FEATURES	107
<i>TABLE 55 SAMPLE CONFIGURATIONS OF DISPLAY BACKLIGHT LEDS</i>	108
MARKET ASSESSMENT.....	109
POSITIVE INDICATORS	109
DISPLAY GROWTH TREND	110
<i>TABLE 56 GLOBAL DEMAND FOR LCD MONITORS, THROUGH 2008 (MILLION UNITS)</i>	110
HIGH BACKLIGHT POTENTIAL	110
IMPACT OF GLOBAL FINANCIAL CRISIS.....	111
<i>TABLE 57 LED MARKET PENETRATION OF LCD MONITORS, THROUGH 2008 (MILLION UNITS/%)</i>	111
FORECAST ASSUMPTIONS—LEDS IN DISPLAY BACKLIGHTING.....	112
<i>TABLE 58 FORECAST ASSUMPTIONS—GROWTH OF LEDS IN THE DISPLAY BACKLIGHTING INDUSTRY</i>	112
ECONOMIC IMPACT	113

<i>TABLE 59 GLOBAL MARKET FORECAST FOR LED GROWTH IN THE DISPLAY BACKLIGHTING INDUSTRY, THROUGH 2014 (MILLION UNITS)</i>	113
FORECAST—SHIPMENTS OF LEDS FOR DISPLAY BACKLIGHTING.....	113
<i>TABLE 60 FORECAST—AVERAGE NUMBER OF LEDS IN DISPLAYS FOR BACKLIGHTING AND AVERAGE COSTS, 2008-2014</i>	114
<i>TABLE 61 GLOBAL MARKET FORECAST OF LED SHIPMENTS FOR DISPLAY BACKLIGHTING, THROUGH 2014 (MILLION UNITS)</i>	114
FORECAST—VALUE OF LED SHIPMENTS.....	115
<i>TABLE 62 GLOBAL FORECAST OF LED SHIPMENT VALUE FOR DISPLAY BACKLIGHTING, THROUGH 2014 (\$ MILLIONS)</i>	115
<i>FIGURE 7 GLOBAL VALUE OF LED SHIPMENTS FOR DISPLAY BACKLIGHTING, 2008-2014 (\$ MILLIONS)</i>	115
FORECAST—INDIVIDUAL LED SHIPMENTS	116
<i>TABLE 63 GLOBAL FORECAST FOR INDIVIDUAL LEDS USED IN LCD DISPLAY BACKLIGHTING, THROUGH 2014 (MILLION UNITS)</i>	116
FORECAST—USE OF SUBSTRATE MATERIALS	117
<i>TABLE 64 GLOBAL USE OF LED SUBSTRATE MATERIALS FOR DISPLAY BACKLIGHTING, 2008-2014 (%)</i>	117
CHAPTER TEN: THE MOBILE LED MARKET	118
MARKET SCOPE.....	118
<i>TABLE 65 REPRESENTATIVE MOBILE PRODUCTS FOR HB-LEDS</i>	119
OTHER LIGHTING METHODS	119
EL Technology	119
Xenon Technology.....	120
TECHNOLOGICAL LED ACTIVITY IN THE MOBILE MARKET	120
<i>TABLE 66 KEY EFFORTS TO PLACE HB-LEDS IN MOBILE DEVICES</i>	121
Driving LED Lighting	121
LED Performance Has Improved	121
ADVANTAGES OF LEDS IN THE MOBILE MARKET.....	122
EASE OF USE.....	122
BRIGHTER SCREENS	122
THINNER DEVICES	123
BETTER CHIP TECHNOLOGY.....	123
BRIGHTER, MORE UNIFORM KEYPADS	123
Light Guides	123
LEDS CAN SERVE AS FLASH UNITS IN MOBILE PHONES	123
<i>TABLE 67 ADVANTAGES OF LEDS IN THE MOBILE MARKET</i>	124
CURRENT MOBILE DEVICE LEDS	124
<i>TABLE 68 SAMPLE CONFIGURATIONS OF MOBILE DEVICE LEDS</i>	124
MOBILE MARKET ASSESSMENT.....	125

A CHANGING MARKET.....	125
COMPETITION.....	125
ORGANIZATION OF MOBILE DEVICES FOR MARKET PROJECTIONS.....	126
MOBILE GROWTH.....	126
TABLE 69 SHIPMENTS OF MOBILE DEVICES, THROUGH 2008 (MILLION UNITS).....	126
FORECAST ASSUMPTIONS—LEDS IN MOBILE APPLICATIONS.....	127
TABLE 70 FORECAST ASSUMPTIONS—LED GROWTH IN THE MOBILE INDUSTRY.....	127
Personal Behavior is a Factor.....	128
TABLE 71 GLOBAL MARKET FORECAST FOR LED GROWTH IN THE MOBILE DEVICE INDUSTRY, THROUGH 2014 (MILLION UNITS).....	128
FORECAST—SHIPMENTS OF LEDES FOR THE MOBILE DEVICE MARKET.....	128
TABLE 72 AVERAGE NUMBER OF LEDES IN DISPLAYS FOR MOBILE DEVICES AND AVERAGE COSTS, 2008-2014.....	129
TABLE 73 GLOBAL MARKET FORECAST OF LED SHIPMENTS FOR MOBILE DEVICES, THROUGH 2014 (MILLION UNITS).....	129
FORECAST—VALUE OF LED SHIPMENTS.....	129
TABLE 74 GLOBAL FORECAST OF THE VALUE OF LED SHIPMENTS FOR THE MOBILE DEVICE INDUSTRY, THROUGH 2014 (\$ MILLIONS).....	130
FIGURE 8 VALUE OF GLOBAL LED SHIPMENTS OF LEDES FOR THE MOBILE DEVICE MARKET, 2008-2014 (MILLIONS).....	130
INDIVIDUAL LED SHIPMENTS.....	131
TABLE 75 GLOBAL FORECAST FOR INDIVIDUAL LEDES USED FOR MOBILE DEVICES, THROUGH 2014 (MILLION UNITS).....	131
FORECAST—SUBSTRATE MATERIALS.....	131
TABLE 76 GLOBAL USE OF LED SUBSTRATE MATERIALS FOR MOBILE DISPLAYS, 2008-2014 (%).....	132
CHAPTER ELEVEN: SIGNALS AND SIGNAGE LED MARKETS.....	133
MARKET SCOPE.....	133
TABLE 77 SAMPLE APPLICATIONS FOR HB-LEDES IN SIGNALING AND SIGNAGE.....	134
DIGITAL SIGNAGE.....	134
LED ACTIVITY IN SIGNALING AND SIGNAGE.....	134
ENERGY STAR Requirements.....	135
LED Signs Continue to Gain Acceptance.....	135
TABLE 78 ADVANTAGES OF USING LEDES FOR ADVERTISING SIGNS.....	135
Combining LEDES with Solar Power.....	135
Key Activities for Signaling and Signage Applications.....	136

<i>TABLE 79 KEY ACTIVITIES FOR HB-LED USE IN SIGNALING AND SIGNAGE</i>	136
ADVANTAGES OF LEDS FOR SIGNALING AND SIGNAGE	
APPLICATIONS	137
SIGNALING APPLICATIONS	137
Energy Savings	137
Longer Lifetimes	138
Increased Safety	138
Environmental and Standards Advantages	138
SIGNAGE APPLICATIONS	139
Energy Savings	139
Ease of Installation	139
Ruggedness of Operations	139
Design Flexibility	140
<i>TABLE 80 ADVANTAGES COMMON TO LED SIGNS AND SIGNALS</i>	140
CURRENT LED SIGNALING AND SIGNAGE LAMPS	140
<i>TABLE 81 SAMPLE CONFIGURATION OF SIGNAL AND SIGNAGE</i>	
LEDS	141
TRAFFIC SIGNAL MODULES	141
CHANNEL LIGHTING SYSTEMS	141
POWER STRIP LIGHTS	142
CONTOUR LIGHTS	142
SIGNALING AND SIGNAGE MARKET ASSESSMENT	142
SIGNALING	142
A Steady Market	143
Signaling Growth and LED Penetration	143
<i>TABLE 82 SHIPMENTS OF SIGNALING DEVICES, THROUGH 2008</i> (MILLION UNITS)	143
SIGNAGE	144
Attractive Signs Help Market	144
Signage Growth	144
<i>TABLE 83 SHIPMENTS OF SIGNAGE DEVICES, THROUGH 2008</i> (MILLION UNITS)	144
FORECAST ASSUMPTIONS—LEDS IN SIGNALING AND SIGNAGE	145
<i>TABLE 84 FORECAST ASSUMPTIONS FOR LED GROWTH IN THE SIGNALING AND SIGNAGE MARKETS</i>	146
<i>TABLE 85 PROJECTED GLOBAL GROWTH OF LEDS IN SIGNALING AND SIGNAGE INDUSTRIES, THROUGH 2014 (MILLION UNITS)</i>	147
FORECAST—SHIPMENTS OF LEDS FOR SIGNALING AND SIGNAGE	147
<i>TABLE 86 AVERAGE NUMBER OF LEDS IN SIGNALING AND SIGNAGE PRODUCTS AND AVERAGE COST, 2008-2014</i>	147

<i>TABLE 87 FORECAST—GLOBAL MARKET FOR SHIPMENTS OF LEDS FOR THE SIGNALING AND SIGNAGE INDUSTRIES, THROUGH 2014 (MILLION UNITS)</i>	148
FORECAST—VALUE OF LED SHIPMENTS.....	149
<i>TABLE 88 FORECAST—VALUE OF GLOBAL LED SHIPMENTS FOR THE SIGNALING AND SIGNAGE APPLICATIONS, THROUGH 2014 (\$ MILLIONS)</i>	149
<i>FIGURE 9 VALUE OF LED SHIPMENTS FOR SIGNALING AND SIGNAGE LEDS, 2008-2014 (\$ MILLIONS)</i>	150
FORECAST—INDIVIDUAL LED SHIPMENTS	150
<i>TABLE 89 GLOBAL FORECAST FOR INDIVIDUAL LEDS USED IN SIGNALING AND SIGNAGE APPLICATIONS, THROUGH 2014 (MILLION UNITS)</i>	151
FORECAST—SUBSTRATE MATERIALS	151
<i>TABLE 90 GLOBAL USE OF LED SUBSTRATE MATERIALS FOR SIGNALING AND SIGNAGE APPLICATIONS, 2008-2014 (%)</i>	152
CHAPTER TWELVE: THE GENERAL ILLUMINATION MARKET.....	153
MARKET SCOPE.....	154
<i>TABLE 91 SCOPE OF THE GENERAL ILLUMINATION MARKET</i>	154
BULB PRODUCT REPRESENTATION	154
<i>TABLE 92 GLOBAL ELECTRICITY CONSUMPTION IN THE GENERAL ILLUMINATION MARKET BY BULB TECHNOLOGY (%)</i>	155
LED ACTIVITY IN GENERAL LIGHTING	155
<i>TABLE 93 KEY GLOBAL EVENTS THAT IMPACT GENERAL LIGHTING</i>	156
Cree Lamp is Bright and Efficient.....	157
Volume Shipments of Recessed Lights	157
Shop and Office Lighting.....	158
LEDs Selected for 650 Walmart Stores	159
LEDs for Street Lighting.....	159
<i>TABLE 94 HIGHLIGHTS IN DEVELOPING LEDS FOR GENERAL ILLUMINATION</i>	160
ADVANTAGES OF LEDS IN GENERAL ILLUMINATION.....	160
LIGHTING EFFICIENCY	160
<i>TABLE 95 EFFICACY OF LEDS, 1998–2014 (LUMENS/WATT)</i>	161
IMPROVED QUALITY OF LIGHT	161
ENVIRONMENTAL BENEFITS.....	161
LONGER LIFETIMES.....	162
DESIGN FLEXIBILITY AND USER CONTROL.....	162
COST EFFECTIVENESS	162
CURRENT LED PRODUCTS FOR GENERAL ILLUMINATION	163
<i>TABLE 96 SAMPLE CONFIGURATIONS OF GENERAL ILLUMINATION LEDS</i>	163

LED DOWNLIGHT FOR COMMERCIAL/RESIDENTIAL APPLICATIONS	163
ARCHITECTURAL LUMINAIRE FOR OFFICES, SCHOOLS, RETAIL STORES.....	164
DOE Helps with Streetlights	164
GENERAL ILLUMINATION APPLICATIONS	165
<i>TABLE 97 KEY APPLICATIONS FOR GENERAL ILLUMINATION</i>	<i>165</i>
GENERAL ILLUMINATION MARKET ASSESSMENT	165
LAMP PRODUCTION	165
<i>TABLE 98 SHIPMENTS OF TRADITIONAL LAMPS FOR LIGHTING, THROUGH 2008 (MILLION UNITS)</i>	<i>166</i>
LEDS ARE A LONG-TERM MARKET	166
<i>TABLE 99 PENETRATION OF LEDS INTO THE GENERAL ILLUMINATION MARKET, THROUGH 2008 (MILLION UNITS)</i>	<i>166</i>
FORECAST ASSUMPTIONS—LEDS IN GENERAL ILLUMINATION	167
<i>TABLE 100 FORECAST ASSUMPTIONS—LED GROWTH IN THE GENERAL ILLUMINATION MARKET</i>	<i>168</i>
<i>TABLE 101 GLOBAL MARKET FORECAST FOR LEDS IN GENERAL ILLUMINATION, THROUGH 2014 (MILLION UNITS)</i>	<i>168</i>
FORECAST—SHIPMENTS OF LEDS FOR GENERAL ILLUMINATION	169
<i>TABLE 102 AVERAGE NUMBER OF LEDS IN ILLUMINATION PRODUCTS AND AVERAGE COST, 2008-2014</i>	<i>169</i>
<i>TABLE 103 FORECAST—GLOBAL LED SHIPMENTS FOR GENERAL ILLUMINATION, THROUGH 2014 (MILLION UNITS)</i>	<i>169</i>
FORECAST—VALUE OF LED SHIPMENTS.....	170
<i>TABLE 104 FORECAST—VALUE OF LED SHIPMENTS FOR GENERAL ILLUMINATION, THROUGH 2014 (\$ MILLIONS)</i>	<i>170</i>
<i>FIGURE 10 VALUE OF GLOBAL LED SHIPMENTS FOR THE GENERAL ILLUMINATION MARKET, 2008-2014 (\$ MILLIONS)</i>	<i>171</i>
FORECAST—SHIPMENTS OF INDIVIDUAL LEDS	171
<i>TABLE 105 GLOBAL FORECAST OF INDIVIDUAL LEDS USED IN GENERAL ILLUMINATION, THROUGH 2014 (MILLION UNITS)</i>	<i>172</i>
FORECAST—SUBSTRATE MATERIALS	172
<i>TABLE 106 GLOBAL USE OF LED SUBSTRATE MATERIALS FOR GENERAL ILLUMINATION APPLICATIONS, 2008-2014 (%)</i>	<i>173</i>
CHAPTER THIRTEEN: INDUSTRY ANALYSIS.....	174
LED UNIT SHIPMENTS	174
<i>TABLE 107 GLOBAL LED SHIPMENTS AND MARKET SHARE BY INDUSTRY, 2008-2014 (MILLION UNITS/%)</i>	<i>174</i>
<i>FIGURE 11 GLOBAL LED UNIT SHIPMENTS BY INDUSTRY 2008-2014 (MILLION UNITS)</i>	<i>175</i>
VALUE OF SHIPMENTS.....	175

<i>TABLE 108 GLOBAL VALUE OF LED SHIPMENTS AND MARKET SHARE BY INDUSTRY, 2008-2014 (\$ MILLIONS/%).....</i>	<i>176</i>
<i>FIGURE 12 VALUE OF GLOBAL LED SHIPMENTS BY INDUSTRY, 2008-2014 (\$ MILLIONS).....</i>	<i>176</i>
<i>VALUE OF SHIPMENTS (CONTINUED).....</i>	<i>177</i>