
LED Lighting Market Shares, Strategies, and Forecasts, Worldwide, 2015 to 2020

LED lamps lower the overall cost of lighting. led lighting costs are less than costs with incandescent lights when you include the cost of energy. led lamps offer up to 50,000 hours of illumination with a fraction of the energy used by traditional incandescent bulbs. LED bulbs generate 90% less heat than incandescent bulbs. LED bulbs extend time between bulb replacements.

Table of Contents

LED Lighting Market Driving Forces	43
Interior and Exterior LED Lights and Controllers	43
Interior A LED Lamps	44
Interior LED PAR Lamps	45
Light-Emitting Diodes Transform The Business Of Illumination	47
LEDs Are Economical	47
LED Lamps Durability	49
LED Controlers Market Driving Forces	52
LED Market Shares	54
LED Lighting Market Forecasts	56
1. LIGHT EMITTING DIODE (LED) LIGHTING MARKET DYNAMICS AND MARKET DESCRIPTION	58
1.1 LED Market Dynamics	58
1.2 LEDs Replace Traditional Incandescent Light Bulb	59
1.3 Next Generation, High-Efficiency, Cost-Saving LED Lighting	60
1.3.1 LED Products	61
1.4 LED Quality Standards	65
1.3.1 LED Backlight TV/Monitor	67
1.3.2 Outdoor Lighting Modules	69
1.5 Life-Cycle Assessment of Energy and Environmental Impacts of LED	74
1.5.1 LED Substrates	81
1.6 Global Economy	84
1.6.1 The IT Market	85
1.6.2 New World Order Built On The Globally Integrated Enterprise	86
1.6.3 Lighting Industry Market Share Commentary on LED Technology Shifts	88



1.7 LED Market Assessment re: Roadblocks	89
2. LIGHT EMITTING DIODE (LED) LIGHTING MARKET SHARES AND MARKET FORECASTS	90
2.1 LED Lighting Market Driving Forces	90
2.1.1 Interior and Exterior LED Lights and Controllers	91
2.1.2 Interior A LED Lamps	92
2.1.3 Interior LED PAR Lamps	92
2.1.4 Light-Emitting Diodes Transform The Business Of Illumination	94
2.1.5 LEDs Are Economical	94
2.1.6 LED Lamps Durability	96
2.1.7 LED Controlers Market Driving Forces	99
2.2 LED Market Shares	101
2.2.1 Philips to Sell Lighting Business	107
2.2.2 Philips Lumileds	108
2.2.3 Philips Targets Lighting for Underdeveloped Regions	109
2.2.4 Philips Luxeon Rebel Power LEDs	110
2.2.5 Philips Automotive LEDs	110
2.2.6 Osram	110
2.2.7 Osram Sylvania	110
2.2.8 Leotek Electronics IL6 Series LED Traffic Signal Modules in 30% of US Intersections	111
2.2.9 China's Leading LED Light Manufacturer GYLED	111
2.2.10 Toshiba LED Lighting	111
2.2.11 Epistar	112
2.2.12 Cree	113
2.2.13 Cree Manufacturing	114
2.2.14 Cree A Leading Innovator Of Lighting-Class Light Emitting Diode (LED)	114
2.2.15 Cree Addresses Emerging Markets	115
2.2.16 Cree Financials	115
2.2.17 GE Lighting Solutions	116
2.2.18 GE ROI for LEDs	116
2.2.19 GE Installs Municipal Lighting	117
2.2.20 Acuity Brands Enhances Popular Lithonia Lighting TWH and TW Luminares with LED Technology	117
2.2.21 QD Vision	120
2.2.22 Lighting Science Group	120
2.2.23 Lighting Science Group Revenue	121
2.2.24 Bridgelux LED Arrays	121
2.2.25 Albemarle	122
2.2.26 Plessey	123
2.2.27 General Electric	124
2.2.28 Pihong	125
2.2.29 AU Optronics / Lextar Electronics	125
2.2.30 Lextar Acquisitions	125
2.2.29 Lite-On Group / Leotek	126





2.2.30 Lowcled	126
2.2.31 Mitsubishi / Verbatim LED Developments	127
2.2.32 Nichia	127
2.2.33 Ohyama Lights	128
2.2.34 LED Lighting Company Trends	128
2.3 LED Lighting Market Forecasts	129
2.3.1 LED Light Shipments Market Forecasts, Units	131
2.3.2 LED Light Shipments Segments Market Forecasts	133
2.3.4 Outdoor Municipal Street Lights and Door LED Lights	137
2.3.5 Commerical LED Light Shipments Market Forecasts	141
2.3.6 LED PAR Residential Light Shipments Market Forecasts	144
2.3.7 LED Residential A and Other Lights Market Forecasts,	149
2.3.8 LED Automotive Light Shipments Market Forecasts Units, Worldwide, 2014-2020	152
2.3.9 LED Traffic Lights Market Forecasts, Dollars, Worldwide, 2014-2020	158
2.4 LED Bulb Prices	161
2.5 Lighting Value: Installed Base and Addressable Market	165
2.6 LED Lighting Market Channel Segment Forecasts	166
2.8 LED Light Addressable Market, Market Penetration Forecasts	169
2.8.1 General Lighting and LED Lighting Installed Base and Market Penetration	171
2.9 Comparison of LED vs. Incandescent Overall Costs	174
2.9.1 Relative ROI Incandescent Lights Compared to LED Lights	177
2.9.2 Energy Star Qualified LED Lamps Increasing	182
2.9.3 LED High Power Streetlights Save 79% and 77% of Energy, Compared With A 250w Sodium And	
Halogen Lights	183
2.9.4 LED Lighting Business Models Shift	183
2.10 LED Market Description	186
2.10.1 LED Markets, Lighting, LCD and TV Displays, Automotive, Cell Phones, Notebooks, Tablets and	
Displays	186
2.10.2 LED Market Growth	188
2.10.3 LED LCD TVs	188
2.10.4 LED Die Surface	189
2.10.5 LED Reflector Lamps	190
2.11 LED Energy Reduction	191
2.11.1 LEDs in LCD Backlighting	191
2.11.2 LED Driver ICs	194
2.11.3 Texas Instrument LED Driver ICs and LED Lighting ICs	197
2.12 LED Lighting ICs	197
2.12.1 LED Signage ICs	198
2.12.2 Backlight ICs	198
2.12.3 Camera Flash ICs	198
2.12.4 Indicator/RGBW ICs	199
2.12.5 Automotive Lighting ICs	199
2.13 Paradigm Shift of the Lighting Industry	200
2.13.13 Lowering Prices of LED Lighting is Key	200

2.13.2 LED Global Market Penetration of 50% Expected by 2015	201
2.14 LED Prices	201
2.14.1 LED Light Bulbs E26 / E27 7W EcoRize	203
2.14.2 Top Ten USA LED Lamps Ratings and Prices	204
2.15 LED Regional Market Analysis	213
2.15.1 LED Global Lighting Trends	215
2.15.2 US LED Lighting	215
2.15.3 China Leverages Supply of Rare-Earth Elements	216
2.15.4 China	217
2.15.5 China Controls Vast Majority Of The Rare-Earth Materials	217
2.15.6 Japan: Ohyama Lights	219
2.15.7 Japan World Leading Country in LED Lighting	219
2.15.8 Japan	220
2.15.9 Cree Revenue by Regional Segment	221
2.15.10 Latin America Governments	223
2.15.11 Philips Targets Lighting for Underdeveloped Regions	224
2.15.12 DMX Tecnologias SA DE CV High Power LED Streetlights in Latin America	225
3. LED LIGHTING PRODUCT DESCRIPTION	226
3.1 GE LED Lighting Solutions	227
3.1.1 General Electric LED Lighting	227
3.1.2 GE RDL Range	228
3.1.3 GE IMMERSION® LED Refrigerated Display Lighting	228
3.1.4 GE Tetra Range	229
3.1.5 GE LED Cove Lighting	230
3.1.6 GE's LED Cove Long Run Fixture System	230
3.1.7 GE Infusion™ M4500 Series	232
3.1.8 GE Infusion™ DLM Series	236
3.1.9 GE Start GLS Bulb	239
3.1.10 GE Infusion™ NPM Series	240
3.1.11 GE Outdoor Stretch of Road Luminaires	240
3.1.12 GE Okapi Flexible LED Outdoor Lighting Solution	243
3.25.13 GE ERS LED	244
3.1.14 GE LED Area Lighter	246
3.1.15 GE Iberia LED	248
3.1.16 GE Duna LED for Residential Areas, Parks And Gardens, Commercial Centres, Pedestrian Walkways And Squares	250
3.1.17 GE ROI for LEDs	252
3.1.18 GE Tetra AL10	253
3.1.19 GE Tetra® miniMAX	254
3.1.20 GE Lumination LED Luminaires - EP Series	256
3.2 Osram	257
3.2.1 Osram Natural Lighting Effects	258
3.2.2 Osram City Lighting	259
3.2.3 Osram Urban safety	261

3.2.4	Osram White Light In The City	262
3.2.5	Osram Potential Savings from LED in Street Lighting	264
3.2.6	Osram White Light Provides Increased Safety	264
3.2.7	Osram Advantages of White LED	264
3.2.8	Osram OLED Orbeos	265
3.2.9	Osram LEAF-Pendant LED	267
3.2.10	Osram Noxlite LED Spot	269
3.2.11	Osram Pursos	271
3.2.12	Osram Optotronic Constant Current LED Power Supplies with LEDset	273
3.2.12	Osram Sylvania	274
3.2.13	Osram Sylvania Integrated LED Lamps	275
3.2.13	Osram Sylvania LED Modules & Arrays	276
3.2.14	Osram Sylvania Optotronics®	277
3.3	Samsung LED Components	278
3.3.1	Samsung LED High Power	279
3.3.2	Samsung LED Middle Power	279
3.3.3	Samsung Outperforms the LED Competition	280
3.2.4	Samsung LED Candle	281
3.3.3	Samsung LED Reflector	283
3.3.4	Samsung LED Light Bulb	284
3.4	Philips Lumileds	285
3.4.1	Philips LUXEON High Power LED Lighting	285
3.4.2	Philips Luxeon Rebel Power LEDs	286
3.4.3	Philips LUXEON c	287
3.4.4	Philips LUXEON Flash LED	287
3.4.5	Philips LUXEON Altilon	287
3.4.6	Philips Mid-Power LEDs	287
3.4.7	Philips Automotive LEDs	288
3.4.8	Philips Quality White Lighting with LEDs	288
3.4.9	Philips Lumileds High Color Rendering Index (CRI)	289
3.4.10	Philips Lumileds Phosphor Deposition Techniques	290
3.4.11	Philips Lumileds LUXEON A	290
3.4.12	Philips Lumileds SignalSure	291
3.4.13	Philips Lumileds SnapLED	292
3.4.14	Philips Lumileds Quality White Lighting with LEDs	293
3.5	Mitsubshi / Verbatim	295
3.5.1	Verbatim	297
3.6	Toshiba	298
3.6.1	Toshiba Lighting Technology	300
3.6.2	Toshiba Lighting the Way	300
3.6.3	Toshiba LED Lighting	311
3.6.4	Toshiba 220-240V	311
3.6.5	Toshiba G25	312
3.6.6	Toshiba DMT6 LED Downlight	315

3.6.7	Toshiba TLS-DCA6 & TLS-DCA8 LED Downlights	316
3.6.8	Toshiba TLS-WP LED Wallpack Lighting	317
3.6.9	Toshiba TLS-ATLS and TLS-ATLM LED Area Lighting	318
3.7	Adata	319
3.7.1	Adata LED Modules	319
3.7.2	Adata Omnidirectional LED Bulb	321
3.7.3	Adata LED Tulip Lamp	323
3.7.4	Adata Tunnel Light	325
3.7.5	Adata Projection Light	326
3.7.6	Adata Warning Light	327
3.7.7	Adata High Bay Light	329
3.7.8	Adata Gas Station Light	331
3.8	Bridgelux	332
3.8.1	Bridgelux OLM Series	334
3.8.2	Bridgelux Vero Series	339
3.8.3	Bridgelux Vero™ Array Series	342
3.8.4	Bridgelux V Series	344
3.8.5	LED Retrofit Bulbs	344
3.8.6	Bridgelux BXRA3 Series	345
3.8.7	Bridgelux LED Chips	348
3.8.8	Bridgelux LS Arrays	349
3.8.9	Bridgelux ES Arrays	351
3.8.10	Bridgelux RS Arrays	353
3.9	Cree	355
3.9.1	Cree Standard A-Type Replacement Bulb	355
3.9.2	Cree Reflector (Flood/Spot)	356
3.9.3	Cree CR80-650L Deep Recess LED Downlight	357
3.9.4	Cree CR4	358
3.9.5	Cree 304 Series Interior	359
3.10	Delta Group	360
3.10.1	Delta Light Engines & Modules	360
3.10.2	Delta LED Lamp and Tube EMS	361
3.10.3	Delta Highbay	362
3.10.4	Delta Canopy	363
3.10.5	Delta Parking Garage	364
3.10.6	Delta Parkway Lighting	365
3.10.7	Delta High Lumen Street Lighting	366
3.11	Everlight	367
3.11.1	Everlight 2835 Package (0.2W)	367
3.11.2	Everlight 5630D Package (0.5W)	368
3.11.3	Everlight Shwo (1W, 3W)	369
3.12	Leotek	370
3.12.1	Leotek Municipal Transportation LED Lighting Products	370
3.12.2	Leotek CIL and CD Series LED Pedestrian Countdown Signal Modules - 16"	370

3.12.3	Leotek CL Series LED Traffic Cabinet Light	371
3.12.4	Leotek LED Railroad Grade Crossing Signal	372
3.12.5	Leotek LED Street and Area Lighting Products	372
3.12.6	Leotek LED Building Mounted Lighting Products	374
3.13	Ledtek	376
3.13.1	Ledtek T8 LED Tube	377
3.14	GYLED	383
3.15	Sengled	390
3.15.1	Sengled LED Street Light	390
3.15.2	Sengled LED Indoor Lighting	390
3.16	ENDO	392
3.16.1	ENDO Adjustable Downlight	393
3.16.2	ENDO Wall Washer Downlight	393
3.16.3	ENDO Dampproof Down Light	393
3.16.4	ENDO Spot Light	394
3.16.5	ENDO Vivid	394
3.16.6	ENDO Moving Gyro System	395
3.16.7	ENDO Indirect Light	395
3.16.8	ENDO Surface Mounted Light	396
3.16.9	ENDO High Power Light	396
3.16.10	ENDO Outdoor Bracket	397
3.17	Plessey	397
3.17.1	Plessey's High Brightness LEDs	398
3.18	Kingsun LED Street Lights: Outdoor LED Lighting and Indoor LED Lighting in China	402
3.18.1	Kingsun---LED Street Light	404
3.18.2	Kingsun LED Street Light---Apollo	406
3.18.3	Kingsun---Solar LED Street Light	406
3.18.4	Kingsun---LED Flood Light	407
3.18.5	Kingsun---LED Parking Light	407
3.18.6	Kingsun---LED Canopy Light	408
3.18.7	Kingsun---LED Tunnel Light	409
3.18.8	Kingsun---LED Courtyard Light	410
3.19	Ohyama Lights	411
3.19.1	Ohyama EDGE-LIT LED PANELS	411
3.19.2	Ohyama LED 4FT Surface Mount with Motion Sensor	412
3.19.3	Ohyama 12" LED Ceiling Light	413
3.19.4	Ohyama LED Highbay - OLHB Series For High-Ceiling Facilities	413
3.20	Sharp LED Lighting	414
3.20.1	 Sharp Mega Zenigata	415
3.20.2	 Sharp Mini Zenigata	415

3.20.3	Sharp		Petite Zenigata	415
3.20.4	Sharp		Tiger Zenigata	415
3.20.5	Sharp		Double Dome	415
3.20.6	Sharp		SAE-Series	416
3.20.7	Sharp LED Solutions			416
3.20.8	Sharp LED Proven Technology			416
3.21	Soraa			416
3.21.1	Soraa MR16 - GU5.3			417
3.21.2	Soraa MR16-GU10			418
3.21.3	Soraa PAR30			419
3.21.4	Soraa PAR38			420
3.21.5	Soraa AR111			421
3.22	SunSun Lighting			422
3.22.1	SunSun LED Bulb			422
3.22.2	SunSun LED Spotlight			423
3.22.3	SunSun LED Tube			424
3.22.4	SunSun LED Par Lamp			425
3.22.5	SunSun LED Downlight			426
3.22.6	SunSun LED Desk Lamp			427
3.23	Crep Optoelectronic			428
3.23.1	Crep 3W G45 Led Bulb			428
3.23.2	Crep 4W G50 Led Bulb			430
3.24	Echelon Outdoor lighting			431
3.25	Shenzen Hoyol			433
3.25.1	Hoyol LED Streetlights			433
3.26	Hong Sheng LED Mining Lamp			433
3.27	Jingge LED Light Curtain			435
3.27.1	Jingge LED Light Source			436
3.27.2	Jingge LED Light Strip			437
3.28	Kingbright			439
3.28.1	Kingbright SMD LED			439
3.28.2	Kingbright Top-Emitting PLCC SMD LED			439
3.28.3	Kingbright Reverse Mount SMD LED			439
3.28.4	Kingbright SOT-23 SMD LED			439
3.28.5	Kingbright Subminiature SMD LED			440
3.28.6	Kingbright Top-Emitting Chip SMD LED			440
3.28.7	Kingbright Right Angle SMD LED			440

3.28.8 Kingbright Multi-Color SMD LED	440
3.29 Koizumi	441
3.30 Lextar LED Lighting	444
3.28.1 Lextar Glass LED Tube	444
3.28.2 Lextar Plastic LED Tube	445
3.28.3 Lextar LED Batten	445
3.31 Nichia	445
3.30.1 Nichia UV-LED	445
3.30.2 Nichia Standard LED	445
3.31 Shenzen Wisdom LED	446
3.31.1 Wisdom RL-MR16-9W-2	446
3.31.2 Wisdom RL-MR16-5024	447
3.32 Zumbotel LED Spotlights	447
3.32.1 Zumbotel LED Discus Evolution	448
3.32.2 Zumbotel Vivo LED R	449
3.33 Zytech	449
3.34 Lighting Science Group	451
3.34.1 Lighting Science Group A19 / A60 Omni	451
3.34.2 Lighting Science Group BR20	452
3.34.3 Lighting Science Group DFN19 / A60	453
3.34.4 Lighting Science Group PAR16	454
3.34.5 Lighting Science Group BayLight	455
3.34.6 Lighting Science Group BayLume	457
3.34.7 Lighting Science Group LED Lamps	458
3.35 Solid State Lighting Systems	462
3.35.1 Solid State Lighting Systems Tilelite	463
3.35.2 Solid State Lighting Systems LED Pool Lights	464
3.35.3 Solid State Lighting Systems Quad Tilelite	465
3.36 LED Microsensor NT	466
3.36.1 LED Microsensor NT Light Emitting Diodes for 1600-2400 nm spectral range	466
3.36.2 LED Microsensor NT Light Emitting Diodes for 2800-5000 nm spectral range	467
3.36.3 LED Microsensor NT LED Chip Design	469
3.37 Acuity Brands Lighting	470
3.37.1 Acuity Brands Indoor LED Solutions	471
3.37.2 Acuity Brands DOM6 LED	471
3.37.3 Acuity Brands REALITY 6" LED Module	472
3.37.4 Acuity Brands ELM2 LED	473
3.38 Litecontrol	474
3.38.1 Litecontrol Wall Arcos LED	474
3.38.2 Litecontrol Aerial	476
3.39 Intematix	477
3.39.1 Intematix ChromaLit™	477
3.39.2 Intematix LED Phosphors	478
3.40 iWatt	479

3.40.1	iWatt iW1760	479
3.40.2	iWatt iW3630	480
3.41	QD Vision QLEDs	480
3.41.1	QLED Technology In Full-Color Displays And Lighting Devices	484
3.41.2	QD Vision	486
3.41.3	QLEDs -- The Future	486
3.41.4	QD Vision QLED Technology	488
3.42	Prolighting TCP	490
3.42.1	ProLighting LED Light Bulbs	491
3.43	ATG Electronics	503
3.44	Utech LED	505
3.45	Advantech Lighting Solutions / NaturaLED	507
3.46	GreeneLED	509
3.47	Light KIW	510
3.48	NuVue	511
3.49	Albemarle Light Emitting Diode (LED) and Compound Semiconductor	515
3.50	Larson	517
3.51	Nichia	522
3.52	Toyoda Gosei	524
3.53	Epistar	527
4	LED LIGHTING TECHNOLOGY	532
4.1	LED Technology Analysis	532
4.2	LED Power Supply Architecture and Primary Side Solutions	539
4.2.1	Single Stage	541
4.2.2	Semi-Single Stage	541
4.2.3	Dual Stage	542
4.2.4	Tri Stage	543
4.3	AC/DC LED Lighting Product Solutions	543
4.3.1	Driving the LEDs	545
4.3.2	Linear	547
4.3.3	Buck	547
4.3.4	Flyback	547
4.3.5	DC/DC LED Lighting Product Solutions	548
4.4	A-Lamp LED Bulb Designs – Edison A15, A19, A21	552
4.5	LED A-Lamp Bulb Reference Designs – Edison A15, A19, A21 LED Lamps	553
4.6	Related LED Lighting Design Resources	554
4.7	R/PAR/BR LED Bulb Designs – R20, PAR20, PAR30, PAR38, BR30, BR40, etc.	555
4.8	LED R/PAR/BR Bulb Reference Designs – R20, PAR20, PAR30, PAR38, BR30, BR40, etc.	556
4.9	Related LED Lighting Design Resources	557
4.10	LED Downlight Designs	557
4.11	LED Downlight Reference Designs	558
	Related LED Lighting Design Resources	559
4.12	GU10 LED Lighting Reference Designs	559
4.13	GU10 LED Lighting Reference Designs	560

4.14 T8 LED Lighting Reference Designs	561
4.15 T8 LED Lighting Reference Designs	561
4.17 MR16 LED Bulb Designs	562
4.17 MR16 Bulb Reference Designs	562
4.18 AR111 LED Lighting Reference Designs	563
4.19 AR111 LED Lighting Reference Designs	564
4.20 150mm GaN-on-Si templates	564
4.21 Light Emitted Or Absorbed In Discrete Packets Called "Photons"	565
4.21.1 Lighting Brand Standards	566
4.21.2 Light-Emitting Diodes LEDs	566
4.22 Institute of the Edison Foundation IEE Measures LED lamps	568
4.2.2 Utility Investments In Electric Efficiency Programs	571
4.4 LEDs Devices Use Semiconductor Materials	572
4.4.1 TriMethyl Gallium (TMG)	574
4.4.2 Triethylgallium (TEG)	574
4.4.3 Trimethylaluminum (TMA-PG)	574
4.4.4. Trimethylgallium (TMG)	575
4.4.5 LED Colors and Common Chemistries	578
4.4.6 White LEDs	578
3.10.3 GaN-on-Si templatesfor LED Lighting	580
4.4.8 Light Emitting Diode (LED): Compound Semiconductor TriMethyl Aluminum (TMA), TriEthyl Gallium (TEG) and TriMethyl Indium (TMI)	580
4.5 Lighting Controls	581
4.5 LED Environmental Dimension	582
4.5.1 Biologically Effective Lighting	582
4.6 Safety Dimension	587
4.6.1 LED Manufacturing Is A Very Complex And Highly Technical Process	590
4.6.2 Lighting Efficiency Comparison	595
4.7 LED Lighting Standards	596
4.1 'R2D2' Project Improves OLED Manufacture	597
4.1.1 Challenges of OLED Production	598
5 LED LIGHTING COMPANY DESCRIPTION	602
5.1 Acuity Brands Lighting	602
5.1.1 Acuity Strategy	606
5.1.2 Acuity Revenue	607
5.1.3 Acuity Products	608
5.1.4 Acuity Customers	609
5.1.5 Acuity Brands Enhances Popular Lithonia Lighting TWH and TWP Luminaires with LED Technology	611
5.1.6 Acuity North America Lighting Market Shares	612
5.2 Adata	618
5.2.1 ADATA Revenue	618
5.3 Advantech Lighting Solutions / NaturalLED	619
5.4 Advanced Lighting Technologies	620

5.4.1	APL Engineered Materials	621
5.4.2	Advanced Lighting Technologies / Venture Lighting International / Sunmaster	622
5.4.3	Venture Advanced Lighting Technologies Company	623
5.4.4	Venture Lighting / Sunmaster Light & Plants	623
5.3.5	Venture Lighting / Sunmaster Hydroponic Product Support	624
5.3.6	Venture Lighting / Sunmaster PAR and Plant Response Curve	624
5.3.7	Sunmaster® Comprehensive Supply of HID Lamps	627
5.3.8	Venture Lighting PAR Watts for Plants	629
5.3.9	Venture Lighting Photons	629
5.3.10	Venture Lighting	631
5.3.11	Venture Lighting Global Perspective	632
5.3.12	Venture Lighting Metal Halide Innovator	633
5.3.13	Venture Lighting International / Sunmaster	634
5.4	Aixtron	635
5.4.1	Aixtron LED Lighting	636
5.4.2	Aixtron Electronics Innovation Technologies	636
5.4.3	Aixtron Made in Germany” Technologies	637
5.4.4	Plessey Semiconductor Expands GaN-on-Silicon LED Production Using Aixtron Technology	637
5.5	Albemarle	638
5.5.1	Albemarle Catalysts	644
5.5.2	Albemarle Discussion	644
5.5.3	Albemarle Discovery in Lithium Carbonate Production	649
5.5.4.	Albemarle Commercial Technology Services	649
5.5.5	Albemarle Pretreat Catalysts	654
5.5.6	Albemarle Catalysts	655
5.6	ATG Electronics	658
5.7	Avances Lumínicos Plus S.A. de C.V	659
5.36	AU Optronics / Lextar Electronics	659
5.8	Black Dog LED	660
5.8.1	Black Dog LED Platinum xl vs. 1000w Hid:Total Cost Of Ownership Analysis	661
5.9	Bridgelux	664
5.9.1	Bridgelux Revenue	667
5.10	CE Lighting	667
5.11	Cree	668
5.11.1	Cree Reportable Segments	670
5.11.2	Cree Revenue	671
5.11.3	Cree LED Lighting	676
5.11.4	Cree Power and Wireless Devices	677
5.11.5	Cree Sets R&D Performance Record with 276 Lumen-Per-Watt Power LED	678
5.11.6	Cree Business	678
5.11.7	Cree LED Lighting Products	679
5.11.8	Cree LED Chips	680
5.11.9	Cree LED Components	680

5.11.10 Cree LED Research and Development	684
5.12 Crep Optoelectronics	684
5.13 Daystar	685
5.14 Delta Group	686
5.14.1 Delta Power Supplies	686
5.14.2 Delta World-	687
5.14.3 Delta Group Plant Factory Control Systems	688
5.14.4 Delta Group Data Center Power	689
5.14.5 Delta Group Renewable Energy Solutions	692
5.14.6 Delta Group Revenue	693
5.15 DMX Tecnologias SA DE CV High Power LED Streetlights in Latin America	698
5.16 Echelon	699
5.17 Emcore	702
5.17.1 Emcore Broadband:	704
5.18 ENDO	705
5.18.1 Endo Business Environment	706
5.18.2 Endo Strategy	706
5.18.3 Endo Technology	712
5.19 Epistar	713
5.19.1 Epistar Revenue	716
5.19.2 Epistar Leads the LED Era	718
5.20 Everlight	719
5.20.1 Everlight Business	719
5.20.2 Everlight Revenue	720
5.20.3 Everlight LED Grow Lights GI Flora	721
5.20.4 Everlight LED Lifestyle Lights	721
5.20.5 Everlight Electronics LED Innovation	722
5.21 GE Lighting Solutions	722
5.21.1 General Electric Lighting	724
5.21.2 GE Tetra EdgeStrip and Tetra miniStrip	724
5.21.3 GE Evolve LED Fixtures Reduce Auto Dealership's Energy Costs by \$49,000 Annually	725
5.21.4 GE Scorecard	727
5.21.5 GE Manufactures Electrical Distribution And Control Products, Lighting And Power Panels, Switchgear And Circuit Breakers	730
5.21.6 GE Home & Business Solutions	730
5.21.7 GE Offers Major Home Appliances	731
5.21.8 GE Lamps	731
5.21.9 GE Lighting Solutions	732
5.21.10 GE Healthcare	732
5.21.11 GE Healthcare Regional P&Ls	733
5.21.12 GE Key Medical Care Areas: Cardiology	734
5.21.13 GE Neurology	735
5.21.14 GE Emergency Medicine	735
5.21.15 GE Oncology	736

5.21.16	GE Women’s Health	736
5.21.17	GE Healthcare Oxygen Humidifier	737
5.21.18	GE Healthcare Air/O2 Blender	740
5.21.19	GE M2100 Air/O2 Blender	741
5.21.20	GE Invests \$100 Million to Grow its LED Lighting Business; Forms New Strategic Alliance	742
5.21.21	GE Supports Innovation	744
5.21.22	General Electric Offers Wind Turbine Customers Clean Energy From Solar Panels	744
5.22	General Hydroponics	746
5.21	Genesis Photonics (GPI)	746
5.21.1	Genesis Photonics Year 2014 Revenue	747
5.21.2	Genesis Photonics 3D COB	747
5.22	GYLED	748
5.22.1	GYLED LED Lights	750
5.22.2	GYLED Grille LED Lights	751
5.22.3	Shanxi Guangyu LED Lighting Co. Ltd. Certifications	753
5.23	Harvatek	755
5.24	Hon Hai	756
5.24.1	Hon Hai Precision Ind. Co. Ltd.	756
5.24.2	Hon Hai Precision Industry Ltd / Foxconn	756
5.24.3	Hon Hai Group Plant Factories	757
5.24.4	Hon Hai Partners	758
5.24.5	Hon Hai Establishes First LED Street Light Production Line in Guizhou	759
5.25	Hong Sheng	760
5.26	IEE	762
5.27	Intematix	762
5.27.1	Intematix Remote Phosphor Takes Lead in LED High Bay Lighting Performance	763
5.27.2	Intematix Phosphor Technology	764
5.27.3	Intematix ChromaLit™ Technology	765
5.28	Iwasaki Electric	768
5.28.1	Iwasaki Revenue	768
5.28.2	Iwasaki’s Quality Oriented Culture	769
5.28.3	Iwasaki EYE Hortilux™	770
5.28.4	EYE Lighting International of North America	784
5.29	iWatt	785
5.29.1	iWatt Flickerless™ SSL LED Driver is Optimized for Commercial Lighting and Wireless Lighting	786
5.30	Jingge LED	789
5.31	Kingbright	790
5.32	Kingsun	791
5.32.1	Kingsun Ranked First in Ten Lighting Brands of 2013 GG-Golden Ball Award	792
5.32.2	Kingsun Won The Bid Of 12.56 Million Rail Transit Lamps Procurement to Increase Market Share	793
5.33	Koizumi	793
5.33.1	Koizumi Market Positioning	794

5.34 Larson	794
5.34.1 Larson Electronics 150 Watt LED Light Fixture that operates on 347/480VAC	805
5.35 LED Microsensor NT	806
5.35.1 LED Microsensor NT Technology	806
5.35.2 LED Microsensor NT Quality	808
5.36 AU Optronics / Lextar Electronics	808
5.36.1 Lextar	809
5.37 Lighting Science Group	809
5.37.1 IEE Names Lighting Science(R) to Top Ten LED Lamp List	811
5.37.2 Lighting Science Group Files Patents	812
5.37.3 Lighting Science Group Business	812
5.37.4 Lighting Science Group Customers	813
5.37.5 Lighting Science Group Products	814
5.37.6 Lighting Science Group Target Markets And Customers	816
5.37.7 Lighting Science Group Strategic Plan	819
5.37.8 Lighting Science Issues Recall of 554,000 LED Bulbs Because Of Fire Hazard	819
5.38 Lightkiwi, LLC.	820
5.39 Litecontrol	821
5.39.1 Litecontrol Mission	821
5.39.2 Litecontrol Aerial Boasts Direct-specific Optical Design	822
5.40 Lite-On Group / Leotek	823
5.40.1 SMD LED Lite-On Group / Leotek	826
5.40.2 Lite-On Technology Revenue	829
5.41 Lowcled	831
5.42 Mitsubishi / Verbatim	832
5.42.1 Verbatim Brand	832
5.42.2 Verbatim LED Developments	833
5.43 Newport Corporation / ILX Lightwave	833
5.43.1 Newport Markets	835
5.43.2 Newport Corporation / ILX Lightwave	836
5.43.3 ILX Lightwave Product Innovation	837
5.44 Nichia	838
5.44.1 Nichia Patent Actions	839
5.45 Nihon Advanced Agri Corporation	841
5.45.1 Nihon Advanced Agri Evolves Agriculture Into Cosmetics And Wellness	842
5.45.2 Nihon Advanced Agri	844
5.45.3 Nihon Advanced Agri Business Description	844
5.45.4 Nihon Advanced Agri Features	845
5.45.5 Nihon Advanced Agri Plant Factory Business	846
5.45.6 Nihon Advanced Agri Ceramics	847
5.46 Osram	849
5.46.1 OSRAM Licht AG	850
5.46.2 Osram Sylvania	851
5.46.3 Osram Sylvania Automotive Lighting	853

5.46.4	Osram Sylvania General Lighting	853
5.46.5	Osram Sylvania Electronic Control Systems	854
5.46.6	Osram Sylvania Display / Optic Lighting	854
5.46.7	Osram Sylvania Canada	855
5.46.8	Osram Sylvania Basic Data	855
5.46.9	Osram Revenue Segments	858
5.46.10	Osram Revenue by Segments	860
5.47	Ohyama / Ohyama Lights	861
5.48	Ozu Corporation	861
5.49	Panasonic	862
5.49.1	Panasonic Global FY 2015 2Q Financial Results	863
5.49.2	Panasonic: Technical Computer Solutions For Business	864
5.49.3	Panasonic: TV	865
5.50	Phihong	865
	Hihong introduces 40w LED Drivers With A New Case & Optional 0-10v Dimming	866
5.50.1	Phihong A World Leader	867
5.50.2	Phihong Lighting Controls	868
5.51	Philips Lumileds	872
5.51.1	Philips Lumileds	874
5.51.2	Philips LED Products	876
5.51.3	Philips Lumileds Quality White Lighting with LEDs	877
5.51.4	Philips Luxeon®	878
5.51.5	Philips Lighting Positioning	881
5.51.6	Royal Philips Electronics Global Presence	881
5.51.7	Philips Enables Consumer Lifestyle	883
5.51.8	Philips Addresses Healthcare Landscape	884
5.51.9	Philips Healthcare Revenue	890
5.51.10	Philips Accelerate! Positioning	891
5.52	Plessey Semiconductors	892
5.52	Pluz S.A. de C.V. / NuVue	895
5.52.1	NuVue	895
5.53	Prolighting TCP	897
5.54	QD Vision	897
5.55	Rambridge	899
5.56	Ringdale ActiveLED®	900
5.57	Samsung	900
5.57.1	Samsung	901
5.57.2	Samsung Strategic Change	902
5.57.3	Samsung Revenue	902
5.57.4	Samsung Apps	904
5.57.5	Samsung Display and Information Technology Innovations	904
5.57.6	Samsung Cameras: Consumer-Inspired Design	904
5.57.7	Samsung Creating a Future Home Entertainment TV	905

5.58 Sengled	906
5.58.1 Sengled Smart LED Lights	907
5.58.2 Sengled Pulse 7.1 LED + Wireless Audio System (C01-BR30 lamp)	908
5.58.3 Sengled Boost LED + Wi-Fi repeater (A01-A60 LED Lamp)	909
5.58.4 Sengled LED Lights	909
5.59 Sharp	915
5.60 Shenzhen Hongsheng Optoelectronic Co., Ltd	917
5.61 Shenzhen Hoyol	918
5.62 Shenzhen LEDTEK Optoelectronics Technology Co., Ltd.	919
5.63 Shenzhen Wisdom	920
5.64 Siemens	921
5.64.1 Siemens Computed Tomography - Multislice CT	922
5.64.2 Siemens Financial Transparency	925
5.64.3 Siemens Urban Development Center – The Crystal – In London – Exhibition Dedicated To Cities	925
5.64.4 Siemens No. 1 in Sustainability – Carbon Disclosure	925
5.64.5 Siemens Revenue Growth in Challenging Markets	926
5.64.6 Siemens Supplies 300 Offshore Wind Turbines to DONG Energy –	926
5.64.7 Siemens Energy Sector	927
5.64.8 Siemens / Radium	927
5.65 Solid State Lighting Systems	927
5.66 Sony	928
5.66.1 Sony HD OLED panels	931
5.67 SolarMax	932
5.68 Soraa	935
5.69 Sunleaves Garden Products	937
5.70 Sunlight Supply	939
5.70.1 Sun System Grow Lights For Indoor And Greenhouse Gardening	940
5.71 SunSun Lighting	940
5.72 Taiwan Floriculture Exports Association	942
5.73 Tatung	944
5.73.1 Tatung Eyes LED Plant Factories as New Growth Driver	944
5.74 TCP	945
5.75 Thorlabs	945
5.75.1 Thorlabs Acquires QCL Manufacturer Maxion Technologies	946
5.75.2 Maxion Technologies	947
5.75.3 Maxion Technologies	948
5.75.4 Maxion Technologies	950
5.75.5 Maxion and the University of Maryland, Baltimore County	952
5.76 TOA Lighting	953
5.76 Toshiba LED Lighting	954
5.76.1 Toshiba Corporation	955
5.76.2 Toshiba International Corporation	956
5.76.3 LED Lighting Systems Division	956

5.76.4	Toshiba World-Leading Diversified Manufacturer	957
5.76.5	Toshiba Medical Systems	958
5.76.6	Toshiba America Medical Systems	960
5.77	Toyoda Gosei	961
5.78	USALight	965
5.79	Zumtobel	965
5.80	Zytech	966

List of Tables and Figures

Table ES-1	46
LED Lamps and Bulbs Market Driving Forces	46
Table ES-2	50
LED Light Durability Drives Market Growth	50
Table ES-3	51
Illumination Grade White LED Light Sources Quality	51
Table ES-4	53
LED Lighting Products Benefits	53
Figure ES-5	55
Light Emitting Diode (LED) Light Market Shares, Dollars, 2014	55
Figure ES-6	57
LED Light Market Forecasts Dollars, Worldwide, 2015-2020	57
Figure 1-1	58
LED Market Dynamics	58
Table 1-1	62
LED System Dimension	62
Table 1-2	63
LED Design Dimension	63
Figure 1-3	64
LED Design Strength	64
Table 1-4	65
LED Quality Standards	65
Figure 1-5	66
LED Quality Dimension: Standards and Regulations	66
Table 1-6	67
LED Backlight TV/monitor – LEDs Used For Screen Lighting	67
Figure 1-7	68
Types of LED Commercial Lighting	68
Figure 1-8	69
Bridgelux LED Commercial Lighting	69
Table 1-9	71
LED Array Features	71
Table 1-10	72
LED Array Benefits	72
Table 1-11	73
LED Module Advantage	73
Table 1-12	73
LED Module Applications	73
Figure 1-13	76
Life-Cycle Assessment Impacts of the Lighting Lamps Analyzed Relative to Incandescent	76
Figure 1-14	78

Life-Cycle Assessment Impacts of the LED Lighting Lamps Analyzed Relative to Impacts Relative To The CFL	78
Figure 1-15	79
Lifecycle Energy Use of Different Lights	79
Figure 1-16	80
LCA Framework	80
Figure 1-17	81
System Boundaries of LED Lifecycle Analysis	81
Figure 1-18	82
Comparison of MOCVD Reactor Tray, 6" vs. 2"	82
Table 1-19	83
LCA Inventory for the 12.5 Watt LED Lamp in 2012 Stage	83
Table 2-1	93
LED Lamps and Bulbs Market Driving Forces	93
Table 2-2	97
LED Light Durability Drives Market Growth	97
Table 2-3	98
Illumination Grade White LED Light Sources Quality	98
Table 2-4	100
LED Lighting Products Benefits	100
Figure 2-5	102
Light Emitting Diode (LED) Light Market Shares, Dollars, 2014	102
Table 2-6	103
LED Lights Market Shares, Dollars, Worldwide, 2013, 2014	103
Table 2-7	104
LED Lights Market Shares, Dollars, Worldwide, First Three Quarters 2014	104
Figure 2-8	105
LED Lighting Market Shares, Dollars, Worldwide, First Three Quarters 2014	105
	108
Table 2-9	108
Philips Limileds LUXEON A Features	108
Table 2-10	118
Acuity Brands Organic Growth Initiative	118
Figure 2-11	119
Acuity LED Sales as a Percent of Total Sales	119
Figure 2-12	122
Albemarle LED Positioning	122
Figure 2-13	130
LED Light Market Forecasts Dollars, Worldwide, 2014-2020	130
Table 2-14	131
LED Lighting Market Shipment Forecasts Dollars, Worldwide, 2014-2020	131
Figure 2-15	132
LED Light Shipments Market Forecasts Units, Worldwide, 2014-2020	132

Table 2-16	133
LED Lighting Market Shipment Segment Forecasts, Commerical, Outdoor, Traffic Light, Automotive, Residential A, and Residential Par, Units and Dollars, Worldwide, 2014-2020	133
Table 2-16 (Continued)	134
LED Lighting Market Shipment Segment Forecasts, Commerical, Outdoor, Traffic Light, Automotive, Residential A, and Residential Par, Units and Dollars, Worldwide, 2014-2020	134
Table 2-16 (Continued)	135
LED Lighting Market Shipment Segment Forecasts, Commerical, Outdoor, Traffic Light, Automotive, Residential A, and Residential Par, Units and Dollars, Worldwide, 2014-2020	135
Figure 2-17	136
LED Floodlights	136
Figure 2-18	137
Outdoor Municipal Street Lights LED Lights	137
Figure 2-19	139
LED Outdoor Light Shipments Market Forecasts, Dollars, Worldwide, 2014-2020	139
Figure 2-20	140
LED Outdoor Light Shipments Market Forecasts, Units, Worldwide, 2014-2020	140
Figure 2-21	142
LED Commerical Light Shipments Market Forecasts Dollars, Worldwide, 2014-2020	142
Figure 2-22	143
LED Commerical Light Shipments Market Forecasts Units, Worldwide, 2014-2020	143
Table 2-23	145
LED PAR Residential Light Features:	145
Figure 2-24	146
LED PAR Lights	146
Figure 2-25	147
LED Residential PAR Light Shipments Market Forecasts Dollars, Worldwide, 2014-2020	147
Figure 2-26	148
LED PAR Residential Light Shipments Market Forecasts Units, Worldwide, 2014-2020	148
Figure 2-27	149
LED Residential A Bulb	149
Figure 2-28	150
LED Residential A and Other Lights Market Forecasts, Dollars, Worldwide, 2014-2020	150
Figure 2-29	151
LED Residential A and Other Light Shipments Market Forecasts Units, Worldwide, 2014-2020	151
Figure 2-30	155
Automotive Ultra Bright SMD LED Light Bulb Towers	155
Figure 2-31	156
LED Automotive Light Shipments Market Forecasts Dollars, Worldwide, 2014-2020	156
Figure 2-32	157
LED Automotive Light Shipments Market Forecasts Units, Worldwide, 2014-2020	157
Figure 2-33	159

LED Traffic Lights Market Forecasts, Dollars, Worldwide, 2014-2020	159
Figure 2-34	160
LED Traffic Lights Market Forecasts, Units, Worldwide, 2014-2020	160
Figure 2-35	162
Typical LED bulbs	162
Figure 2- 36	166
LED Lighting Market Channel Segment Forecasts, Electrical Wlolesalers, Home Centers, and Utilities, Units and Dollars, Worldwide, 2014-2020	166
Figure 2-36 (Continued)	167
LED Lighting Market Channel Segment Forecasts, Electrical Wlolesalers, Home Centers, and Utilities, Units and Dollars, Worldwide, 2014-2020	167
Figure 2-36 (Continued)	168
LED Lighting Market Channel Segment Forecasts, Electrical Wlolesalers, Home Centers, and Utilities, Units and Dollars, Worldwide, 2014-2020	168
Figure 2-37	170
LED Light Addressable Market Penetration, Market Forecasts Percent, Worldwide, 2013-2019	170
Figure 2-38	172
LED Lights, Units, Shipments, Installed Base, and Market Penetration, Worldwide, 2013-2019	172
Figure 2-39	174
Area/street LED Lighting Block Diagram	174
Figure 2-40	175
Cost Differences, LED Light vs. Incandescent, Dollars, Worldwide, 2014	175
Figure 2-41	176
Comparison of LED vs. Incandescent Overall Costs for 50,000 Hours of Luminescence, Dollars, 2012	176
Table 2-42	178
LED Lights ROI Analysis Dollars, Worldwide, 2012	178
Figure 2-43	179
Incandescent Light Bulb Costs for 50,000 Hours of Light, Dollars, 2012	179
Figure 2-44	180
Light Emitting Diodes (LEDs) Market Segments, Dollars, 2012	180
Figure 2-45	181
Incandescent and LED Lighting ROI Comparison, Energy, Maintenance, and Investment Dollars, Worldwide, 2012	181
Figure 2-46	182
Energy Star Qualified LED Lamps Increasing Over Time	182
Table 2-47	184
LED Lighting Business Models Shift	184
Table 2-48	185
Mega Trends: LED Market Adoption	185
Table 2-49	186
LED Uses: Backlight TV/monitor – LEDs Used For Screen Lighting	186
Table 2-22	186
LED Markets, Lighting, LCD and TV Displays, Automotive, Cell Phones,	

Notebooks, Tablets and Displays, Dollars and Units Shipments, Worldwide, 2013-2019	186
Figure 2-50	190
Common Uses of Reflector Lamps	190
Table 2-51	192
Lighting Energy Dimension	192
Figure 2-52	195
Led Driver Units	195
Figure 2-53	202
LED Light Bulbs E26 / E27 3W EcoNorm	202
Figure 2-54	213
LED Lighting Regional Market Segments, Dollars, 2013	213
Table 2-55	214
LED Lighting Regional Market Segments, Dollars, 2013	214
Table 2-56	215
LED Global Lighting Trends	215
Table 2-57	223
Cree Revenue by Country Percent, Worldwide, 2007-2012	223
Figure 3-1	228
GE RDL Range	228
Figure 3-2	229
GE Tetra Range	229
Figure 3-3	230
GE LED Cove Lighting	230
Table 3-4	231
GE's LED Cove Long run Fixture System Features	231
Table 3-5	231
GE LED Benefits	231
Figure 3-6	232
GE Infusion™ M4500 Series	232
Table 3-7	233
GE Infusion™ M4500 Series Features & Benefits	233
Figure 3-8	234
GE Infusion™ NPM Series	234
Table 3-9	235
GE Infusion™ NPM Series Retail, Galleries, And Other Display Applications Features & Benefits	235
Figure 3-10	236
GE Infusion™ DLM LED Series	236
Table 3-11	237
GE Infusion™ DLM LED Series Applications	237
Table 3-12	238
GE Infusion™ DLM Series Features & Benefits	238
Figure 3-13	239
GE Start GLS Bulb	239

Figure 3-14	240
GE Infusion™ NPM Series	240
Table 3-15	242
GE Benefits Of White Light	242
Table 3-16	243
GE White LED Light Functions	243
Figure 3-17	243
GE Okapi LED	243
Table 3-18	244
GE Okapi LED Lumin Features	244
Figure 3-19	244
GE ERS LED	244
Table 3-20	245
GE ERS LED Scalable Fixtures	245
Figure 3-21	246
GE LED Area Lighter	246
Figure 3-22	247
GE LED Area Lighter Features	247
Figure 3-23	248
GE Iberia LED	248
Table 3-24	249
GE Iberia LED Functions	249
Figure 3-25	250
GE Duna LED	250
Table 3-26	251
GE Duna LED Features	251
Figure 3-27	253
GE Tetra AL10	253
Table 3-28	254
GE Tetra AL10 Features	254
Table 3-29	255
GE Tetra® miniMAX Features	255
Figure 3-30	256
GE Lumination LED Luminaires - EP Series	256
Table 3-31	257
GE Lumination LED Luminaires - EP Series Features	257
Figure 3-32	260
Osram City Lighting	260
Figure 3-33	261
Osram LED Trend: Roadway Lighting, Attractive City Design	261
Figure 3-34	263
Osram Street Lighting Savings ROI	263
Figure 3-35	265
Osram OLED Orbeos	265

Table 3-36	266
Osram OLED Orbeos Product Benefits	266
Table 3-37	266
Osram OLED Orbeos Areas of Application	266
Figure 3-38	267
Osram LEAF-Pendant LED	267
Figure 3-39	268
Osram LEAF-Pendant LED Functions	268
Figure 3-40	269
Osram Noxlite LED Spot	269
Figure 3-41	270
Osram Noxlite LED Spot Functions	270
Figure 3-42	271
Osram Pursos	271
Figure 3-43	272
Osram Pursos Features	272
Figure 3-44	273
Osram OPTOTRONIC Constant Current LED Power Supplies with LEDset	273
Table 3-45	274
Osram OPTOTRONIC Constant Current LED Power Supplies with LEDset Features	274
Figure 3-46	275
Osram Sylvania Integrated LED Lamps	275
Figure 3-47	276
Osram Sylvania LED Modules & Arrays	276
Table 3-48	278
Samsung LED Components Advantages	278
Figure 3-49	279
Samsung LED High Power	279
Figure 3-50	281
Samsung LED Candle	281
Figure 3-51	283
Samsung LED Reflector	283
Figure 3-52	284
Samsung LED Light Bulb	284
Table 3-53	286
Philips Luxeon High Power LEDs Benefits	286
Table 3-54	290
Philips Limileds LUXEON A Features	290
Table 3-55	291
Philips Limileds SignalSure Uses	291
Table 3-56	292
Philips Limileds SnapLED Uses	292
Table 3-57	293
Philips LUXEON® 3535 2D Mid-Power LED Features	293

Figure 3-58	295
Mitsubshi LED Light Source Equipped with RGB	295
Figure 3-59	296
Mitsubshi LED and Lamp Light Source Range	296
Table 3-60	297
Verbatim BR30 LED Bulb	297
Table 3-61	299
Toshiba offers TLS-RTLS and TLS-RTLM LED Roadway Lighting Features	299
Table 3-62	301
Toshiba LED Lighting Features	301
Table 3-63	302
Toshiba LED Lighting Applications –	302
Table 3-64	302
Toshiba LED Lighting Construction –	302
Table 3-65	303
Toshiba LED Lighting Mounting –	303
Table 3-66	304
Toshiba LED Lighting Optics –	304
Table 3-67	306
Toshiba Roadway LED Key Benefits	306
Table 3-68	307
Toshiba LED Lamps	307
Table 3-69	311
Toshiba 220-240V LED Lighting Features	311
Figure 3-70	312
Toshiba g25 LED Bulb	312
Table 3-71	313
Toshiba G25 LED Products	313
Table 3-72	314
Toshiba g25 LED Features	314
Table 3-73	315
Toshiba DMT6 LED Downlight Features	315
Table 3-74	316
Toshiba TLS-DCA6 & TLS-DCA8 LED Downlight Features	316
Table 3-75	317
Toshiba TLS-WP LED Wallpack Lighting Features	317
Table 3-76	318
Toshiba TLS-ATLS and TLS-ATLM LED Area Lighting Features	318
Figure 3-77	319
Adata LED Modules	319
Table 3-78	320
Adata LED Chip Benefits	320
Figure 3-79	321
Adata Omnidirectional LED Bulb	321

Table 3-80	322
Adata 270°Wide Angle Bulb Design Benefits	322
Table 3-81	323
Adata LED Bulb Indoor Application Environments	323
Figure 3-82	324
Adata LED Tulip Lamp	324
Figure 3-83	325
Adata Tunnel Light	325
Figure 3-84	326
Adata Projection Light	326
Figure 3-85	327
Adata Warning Light	327
Figure 3-86	329
Adata High Bay Light	329
Figure 3-87	330
Adata High Bay Light Features	330
Figure 3-88	331
Adata Gas Station Light	331
Figure 3-89	332
Adata Gas Station Light Features	332
Figure 3-90	333
Bridgelux LED Arrays	333
Figure 3-91	334
Bridgelux OLM Series	334
Table 3-92	335
Bridgelux Vero Series Features	335
Table 3-93	336
Bridgelux Vero Series Benefits	336
Table 3-94	337
Bridgelux OLM Advantage	337
Table 3-95	338
Bridgelux Vero Series Applications	338
Figure 3-96	339
Bridgelux Vero Series	339
Table 3-97	340
Bridgelux Vero Features	340
Table 3-98	341
Bridgelux Vero Benefits	341
Table 3-99	341
Bridgelux Vero Advantage	341
Table 3-100	342
Bridgelux Vero Applications	342
Figure 3-101	342
Bridgelux Vero™ Array Series	342

Table 3-102	343
Bridgelux Vero™ Array Series Functions	343
Figure 3-103	344
Bridgelux V Series	344
Table 3-104	345
LED Retrofit Bulb Applications	345
Figure 3-105	345
Bridgelux BXRA3 Series	345
Table 3-106	346
Bridgelux BXRA3 LED Array Features	346
Table 3-107	347
Bridgelux BXRA3 LED Benefits	347
Table 3-108	347
Bridgelux BXRA3 LED Applications	347
Table 3-109	348
Bridgelux LED Chips	348
Figure 3-110	349
Bridgelux LS Arrays	349
Table 3-111	350
Bridgelux LS Arrays Features	350
Figure 3-112	351
Bridgelux ES Arrays	351
Table 3-113	352
Bridgelux ES Arrays Features	352
Figure 3-114	353
Bridgelux RS Arrays	353
Figure 3-115	354
Bridgelux RS Arrays Features	354
Figure 3-116	355
Cree Standard A-Type	355
Figure 3-117	356
Cree Reflector (Flood/Spot)	356
Figure 3-118	357
Cree CR80-650L Deep Recess LED Downlight	357
Figure 3-119	358
Cree CR4	358
Figure 3-120	359
Cree 304 Series Interior	359
Figure 3-121	360
Delta Light Engines & Modules	360
Figure 3-122	361
Delta LED Lamp and Tube EMS	361
Figure 3-123	362
Delta Highbay	362

Figure 3-124	363
Delta Canopy	363
Figure 3-125	364
Delta Parking Garage	364
Figure 3-126	365
Delta Parkway Lighting	365
Figure 3-127	366
Delta High Lumen Street Lighting	366
Figure 3-128	367
Everlight 2835 Package (0.2W)	367
Figure 3-129	368
Everlight 5630D Package (0.5W)	368
Figure 3-130	369
Everlight Shwo (1W, 3W)	369
Table 3-131	371
Leotek CIL and CD Series LED Pedestrian Countdown Signal Modules Features	371
Table 3-132	372
Leotek LED Railroad Grade Crossing Signal Features	372
Table 3-133	377
Ledtek LEDs	377
Figure 3-134	383
GYLED Lights	383
Table 3-135	399
Plessey Solid-State LED Lighting Functions	399
Table 3-136	400
Plessey LEDs for Solid-State Lighting Benefits	400
Figure 3-137	401
Plessey Semiconductor LED Positioning	401
Figure 3-138	403
Kingsun LED Street Light	403
Table 3-139	405
Kingsun---LED Street Light Types	405
Figure 3-140	409
Kingsun Optoelectronic Flow Chart	409
Figure 3-141	410
Kingsun LED Lens Quantity	410
Figure 3-142	411
Kingsun---LED Courtyard Light	411
Figure 3-143	432
Echelon Outdoor Lighting Systems	432
Figure 3-144	442
Koizumi LED Lighting Targets Store Lighting	442
Figure 3-145	443
Koizumi LED Lighting Positioning	443

Figure 3-146	451
Lighting Science Group A19 / A60 Omni	451
Table 3-147	452
Lighting Science Group A19 / A60 Omni Features	452
Figure 3-148	452
Lighting Science Group BR20	452
Figure 3-149	453
Lighting Science Group DFN19 / A60	453
Figure 3-150	454
Lighting Science Group PAR16	454
Figure 3-151	455
Lighting Science Group BayLight	455
Table 3-152	456
Lighting Science Group BayLight Features	456
Figure 3-153	457
Lighting Science Group BayLume	457
Table 3-154	458
Lighting Science Group BayLume Features	458
Figure 3-155	459
Lighting Science Group LED Lights	459
Figure 3-156	460
Lighting Science Group LED Lights	460
Table 3-157	461
Lighting Science Group MR16 GU10 Features	461
Figure 3-158	463
Solid State Lighting Systems Tilelite	463
Figure 3-159	464
Solid State Lighting Systems LED Pool Lights	464
Figure 3-160	465
Solid State Lighting Systems Quad Tilelite	465
Figure 3-161	466
LED Microsensor NT Light Emitting Diodes for 1600-2400 nm spectral range	466
Table 3-162	467
LED Microsensor NT Light Emitting Diodes for 1600-2400 nm spectral range Features	467
Figure 3-163	468
LED Microsensor NT Light Emitting Diodes for 2800-5000 nm spectral range	468
Table 3-164	469
LED Microsensor NT Light Emitting Diodes for 2800-5000 nm spectral range	469
Figure 3-165	469
LED Microsensor NT LED Chip Design	469
Table 3-166	470
LED Microsensor NT LED Chip Design Features	470
Figure 3-167	471
Acuity Brands DOM6 LED	471

Figure 3-168	472
Acuity Brands REALITY 6" LED Module	472
Figure 3-169	473
Acuity Brands ELM2 LED	473
Figure 3-170	474
Litecontrol Wall Arcos LED	474
Table 3-171	475
Litecontrol Wall Arcos LED	475
Figure 3-172	476
Litecontrol Aerial	476
Figure 3-173	477
Intematix ChromaLit™	477
Table 3-174	478
Intematix ChromaLit™	478
Table 3-175	481
QLED Benefits For The Solid State Lighting	481
Figure 3-176	483
QD Vision QLED performance	483
Table 3-177	485
QLED Technology Benefits In Color Displays / Lighting Devices	485
Figure 3-178	487
QD Vision QLEDS	487
Table 3-179	488
QLED Features	488
Figure 3-180	490
Prolighting TCP LEDs	490
Figure 3-181	492
Prolighting TCP LEDs	492
Figure 3-182	504
ATG Electronics LEDs	504
Figure 3-183	505
Utech Led Accessories	505
Figure 3-184	508
Advantech Lighting Solutions / NaturaLED	508
Figure 3-185	509
GreeneLED Sample Products	509
Figure 3-186	510
Lightkiwi, LLC. LED Lights	510
Figure 3-187	511
NuVue MR16 6*1W (7W)Max	511
Figure 3-188	512
NuVue.LED	512
Figure 3-189	516
Albemarle LED Positioning.	516

Figure 3-190	519
Larson Electronics Tower LED Lights	519
Figure 3-191	523
Nichia LED Series Offerings	523
Figure 3-192	525
Toyoda Gosei Blue LED Technology Products	525
Figure 3-193	526
Toyoda Gosei LED Solutions	526
Figure 3-194	527
Toyoda Gosei Amusement Equipment LED Solutions	527
Figure 3-195	528
Epistar LEDs Lighting Arrangement	528
Figure 3-196	529
Epistar LED Lighting Potential	529
Figure 3-197	530
Epistar LED Lighting Decorations	530
Figure 3-198	531
Epistar LED Lighting	531
Table 4-1	532
LED Lighting Market Technology Segment Forecasts, InGaN Low Power, InGaN Mid Power, InGaN Hi Power InGaAIP Low Power, InGaAIP Mid Power, and InGaAIP Hi Power, Units and Dollars, Worldwide, 2014-2020	532
Table 4-1 (Continued)	533
LED Lighting Market Technology Segment Forecasts, InGaN Low Power, InGaN Mid Power, InGaN Hi Power InGaAIP Low Power, InGaAIP Mid Power, and InGaAIP Hi Power, Units and Dollars, Worldwide, 2014-2020	533
Table 4-1 (Continued)	534
LED Lighting Market Technology Segment Forecasts, InGaN Low Power, InGaN Mid Power, InGaN Hi Power InGaAIP Low Power, InGaAIP Mid Power, and InGaAIP Hi Power, Units and Dollars, Worldwide, 2014-2020	534
Table 4-2	535
Plessey LEDs for Solid-State Lighting Benefits	535
Figure 4-3	538
Albemarle Projected LED Materials Growth	538
Figure 4-4	540
LED Power Supply Architectures	540
Figure 4-5	569
IEE Top Ten LED Lamp List, 2013	569
Figure 4-6	570
Energy Star Qualified LED Lamps	570
Table 4-7	571

TABLE 4-7	
UTILITY INVESTMENTS IN ELECTRIC EFFICIENCY PROGRAMS	
Program cost recovery	
Fixed cost recovery	
Performance incentives	
Work for electric utilities on a state-by-state basis	
SOURCE: WINTERGREEN RESEARCH, INC.	

571

Utility Investments In Electric Efficiency Programs	571
Source: WinterGreen Research, Inc.	571
Figure 4-8	573
Albemarle Well Positioned To Thrive As LED Market Adoption Occurs	573
Figure 4-9	575
Gains from Disruptive Manufacturing Technologies: GaN-on-GaN, GaN-on-Si	575
Figure 4-10	577
Soraa Inc LED Large Surface Area To Junction Area	577
Table 4-11	578
LED Colors and Common Chemistries	578
Figure 4-12	579
Global Lighting Association Solid State Lighting SSL Performance Roadmap	579
Figure 4-13	581
LED Lighting Controls	581
Table 4-14	582
LED Environmental Dimension	582
Source: WinterGreen Research, Inc.	582
Table 4-15	583
Biologically Effective Lighting	583
Source: WinterGreen Research, Inc.	583
Table 4-16	584
LED Light Benefits	584
Source: WinterGreen Research, Inc.	584
Table 4-17	585
LED Biological Dimension Implementation	585
Figure 4-18	586

LED Biological Dimension Illustration	586
Figure 4-19	588
General Types of White Light Emitting Diodes LEDs	588
Figure 4-20	591
Stages And The Major Steps of LED Manufacturing	591
Figure 4-21	593
Steps Associated with Sapphire Wafer Substrate Manufacture	593
Figure 4-22	594
Philips Example of Finished Packaged LED	594
Figure 4-23	595
Efficacy of Conventional Light Sources Versus LEDs.	595
Figure 4-24	596
ATG Electronics Standards Compliance	596
Figure 4-25	597
Flexible OLED Lighting Systems	597
Figure 4-26	599
Flexible OLEDs Made By Roll-To-Roll Manufacturing	599
Table 4-27	600
Aims of OLED Production	600
Table 4-28	600
Challenges of OLED Production	600
Figure 5-1	610
Acuity Target Customers	610
Figure 5-2	612
Acuity North America Lighting Market Shares	612
Figure 5-3	613
Acuity Strategy	613
Figure 5-4	614
Acuity Organic Growth Strategy	614
Figure 5-5	615
Acuity Tiered Solution Strategy	615
Figure 5-6	616
Acuity Market Opportunity in Lighting	616
Figure 5-7	617
Acuity Acquisition Strategy	617
Figure 5-8	625
Venture Lighting International Human Eye Response Curve	625
Figure 5-9	626
Venture Lighting / Sunmaster Plant Response Curve	626
Figure 5-10	628
Venture Lighting Efficiencies of Light Sources Used in Plant Growth	628
Figure 5-11	642
Albemarle Well Positioned To Thrive As LED Market Adoption Occurs	642
Table 5-12	645

Albemarle Business Segments	645
Figure 5-13	646
Albemarle Refinery Catalyst Solutions	646
Figure 5-14	647
Albemarle Performance Catalyst Solutions	647
Figure 5-15	648
Albemarle Global Expansion	648
Table 5-16	651
Albemarle Process Additives	651
Figure 5-17	663
Black Dog LED Platinum XL ROI Cost Savings Running Total	663
Table 5-18	673
Cree Licensees And The License Description	673
Table 5-19	682
Cree Lighting Portfolio Of Lighting Products Applications.	682
Table 5-20	683
Cree LED Research and Development Issues	683
Figure 5-21	689
Delta Group Data Center Power	689
Figure 5-22	690
Delta Group Data Center Power Infrasuite Components	690
Table 5-23	691
Delta Group InfraSuite Advantages	691
Figure 5-24	692
Delta Group Renewable Energy Solutions	692
Figure 5-19	710
Endo LEDZ Lighting Brightness Retention	710
Figure 5-20	711
Endo Service Life Of White LEDs	711
Figure 5-25	714
Epistar Management's Beliefs	714
Figure 5-26	715
Epistar Headquarters	715
Figure 5-27	727
GE Scorecard 2013, 2012	727

2013 PERFORMANCE

CONSOLIDATED REVENUES (In \$ billions)



SEGMENT PROFIT (In \$ billions)



OPERATING EARNINGS PER SHARE



GE CFOA (In \$ billions)



*Excludes NBCUniversal deal-related taxes

GE Scorecard

Industrial Segment Profit Growth	5%	Return on Total Capital	11.3%
Cash from GE Capital	\$6B	GE Capital Tier 1 Common Ratio	11.2%
Margin Growth	60bps	GE Year-End Market Capitalization	\$282B, +\$64B
Cash Returned to Investors	\$18.2B	GE Rank by Market Capitalization	#6

GE 2014

727
728

Scorecard

The Milken Institute prepared the Innovation Scorecard for GE. The 22 markets surveyed were ranked on seven key indicators based on the top 100 countries in the World Economic Forum's Global Competitiveness Report 2011-2012. They were then placed in a quartile (leading, above average, below average, or lagging) based on their performance. To view a full country profile, scroll over a country and click.

● Leading
 ● Above Average
 ● Below Average
 ● Lagging
 ● Unavailable



[View Ranking Methodology >](#)

Source: Milken Institute.

Figure 5-28	728
GE Healthcare Oxygen Humidifier	728
Table 5-29	737
GE Healthcare Oxygen Humidifier	737
Figure 5-30	739
GE Healthcare Air/O2 Blender	739
Figure 5-31	740
Intematix ChromaLit	740
Table 5-32	766
Intematix ChromaLit Future Features	766
Figure 5-33	767
Iwasaki Electric, Ltd New Generation Dimmable High-Bay Fixture	767
Figure 5-34	773
	773
	774

Iwasaki Electric, Ltd Commercial Lighting Examples	774
Figure 5-35	775
Iwasaki Electric, Ltd High Speed Capture Lighting	775
Figure 5-36	776
Iwasaki Electric, Ltd Light Source for Image Operation	776
Figure 5-37	777
Iwasaki Electric, Ltd Halogen Heater	777
Figure 5-38	778
Iwasaki Electric, Ltd Halogen Lamp	778
Figure 5-39	779
Iwasaki Electric, Ltd Insect Repelling Lamp	779
Figure 5-40	780
Iwasaki Electric, Ltd Plant Factory Light For Cultivation	780
Figure 5-41	781
Iwasaki Electric, Ltd Light Source for Image Processing	781
Figure 5-42	782
Iwasaki Electric, Ltd Infrared LED Board	782
Figure 5-43	783
Iwasaki Electric, Ltd EYE Black Lamp	783
Table 5-44	786
iWatt Mission	786
Table 5-45	789
iWatt iW3630 Key Features	789
Figure 5-46	796
LarsonElectronics Product Categories	796
Table 5-47	797
LarsonElectronics Lighting Products	797
Figure 5-48	807
Semiconductor Wafer After The Photolithography Stage	807
Table 5-49	822
Litecontrol Values	822
Figure 5-50	825
Lite-on LED Products	825
Figure 5-51	826
Lite-On Group / Leotek SMD LED	826
Figure 5-52	827
Lite-On Group / Leotek Automotive Chip LED Component	827
Figure 5-53	828
Lite-On Group / Leotek Automotive Chip LED Components	828
Table 5-54	843
Nihon Advanced Agri Business Activities	843
Figure 5-55	848

Study of Nano Materials: Hiromi Nakano in Toyohashi Tech’s Cooperative Research Facility Center	848
Table 5-56	852
Osram Sylvania Business Sectors	852
Table 5-57	855
Osram Sylvania Basic Data	855
Figure 5-58	857
Osram Sylvania Revenue	857
Table 5-59	868
Phihong Lighting LED Products	868
Table 5-60	869
Phihong Lighting Target Markets	869
Table 5-61	870
Phihong Lighting Driver Products	870
Table 5-62	871
Phihong Lighting Driver Models	871
Table 5-63	879
Philips Luxeon® Features	879
Table 5-64	880
Philips Luxeon® LED Functions	880
Figure 5-65	882
Philips Global Presence	

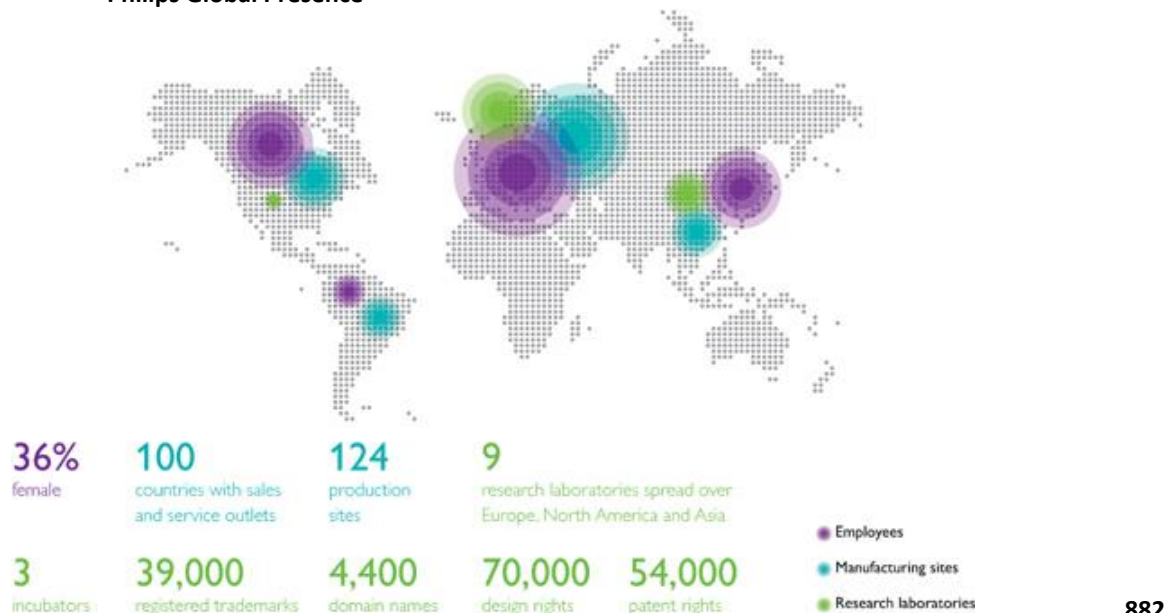


Figure 5-66	882
Philips Global Trends And Challenges	884
Table 5-67	884
Philips Positions To Simplify Global Healthcare Delivery For The Long Term	886
	886

Table 5-68	887
Philips Healthcare Delivery Product Positioning	887
Figure 5-69	889
Philips Delivering Margin Improvement and Decreasing Manufacturing Overhead	889
Figure 5-70	890
Philips Healthcare Information Systems Market Shares	890
Figure 5-71	894
Plessey Strategy Focus	894
Table 5-72	896
Nu Vue Lighting LLC Strategic Positioning	896
Figure 5-73	899
Rambridge Brands	899
Table 5-74	908
Sengled Pulse LED Bulb Product Specifications:	908
Figure 5-75	912
Sengled LED Locations in China	912
Figure 5-76	914
Sengled LED Lights	914
Figure 5-77	923
Siemens Somatom Computed Tomography CT	923
Figure 5-78	933
Solarmax HPS Lamps	933
Figure 5-79	934
SolarMax™ HPS Lamps Radiation From The "Red" Portion Of The Spectrum	934
Table 5-80	937
Soraa GaN on GaN™ LEDs Benefits	937
Figure 5-81	938
Sunleaves Product Stacks	938
Table 5-82	951
Maxion Technologies Laser Product Segment Positioning	951
Figure 5-83	959
Toshiba CT Scan Roadmap for Dose Reduction	959
Figure 5-84	960
Toshiba CT	960
Figure 5-85	962
Toyoda Gosei Business Performance	962
Figure 5-86	963
Toyoda Gosei Business Performance	963
Figure 5-87	964
Toyoda Gosei Principal Customers	964

