

<u>CHAPTER ONE: INTRODUCTION</u>	1
<u>GOALS AND OBJECTIVES</u>	2
<u>INTENDED AUDIENCE</u>	3
<u>SCOPE AND FORMAT</u>	3
<u>METHODOLOGY</u>	4
<u>AUTHOR'S CREDENTIALS</u>	4
<u>RELATED BCC RESEARCH</u>	4
<u>BCC ONLINE SERVICES</u>	5
<u>DISCLAIMER</u>	6
 <u>CHAPTER TWO: EXECUTIVE SUMMARY</u>	 7
<u>SUMMARY TABLE U.S. MARKET FOR SMART GRID</u> <u>TECHNOLOGIES, THROUGH 2014 (\$ MILLIONS)</u>	7
<u>SUMMARY FIGURE U.S. MARKET FOR SMART GRID</u> <u>TECHNOLOGIES, 2007-2014 (\$ MILLIONS)</u>	8
<u>DEFINITIONS</u>	9
<u>BENEFITS OF SMART GRIDS</u>	9
<u>DIRECT BENEFITS</u>	9
<u>Benefits to Utilities</u>	9
<u>Lower Capital Costs</u>	9
<u>Reduced Operating Costs</u>	10
<u>Benefits to Users</u>	11
<u>Improved Quality and Reliability</u>	11
<u>Lower Costs</u>	11
<u>FIGURE 1 AVERAGE RETAIL PRICE OF ELECTRICITY, 2000-2008</u> <u>(CENTS/KWH)</u>	12
<u>Greater Consumer Choice</u>	12
<u>INDIRECT BENEFITS</u>	13
<u>Reduced Consumption of Fossil Fuels</u>	13
<u>FIGURE 2 U.S. ELECTRICITY GENERATION BY FUEL TYPE, 2006</u> <u>(%)</u>	13
<u>FIGURE 2 (CONTINUED)</u>	14
<u>TABLE 1 U.S. CONSUMPTION OF FOSSIL FUELS FOR ELECTICITY</u> <u>GENERATION, THROUGH 2007</u>	14
<u>Improved Balance of Payments Position</u>	15
<u>FIGURE 3 U.S. FOSSIL FUEL IMPORTS, 2007 (PERCENT OF TOTAL</u> <u>FOSSIL FUEL IMPORTS)</u>	15
<u>Enhanced National Security</u>	16
<u>Job Creation</u>	16
<u>Economic Development</u>	17
<u>Environmental Benefits</u>	17
<u>THE PATH TO A SMART GRID</u>	18
<u>GRID 2030</u>	18
<u>Regional Interconnections</u>	19

<u>Local Distribution, Mini- and Micro-Grids</u>	20
<u>NATIONAL ELECTRIC DELIVERY TECHNOLOGIES</u>	
<u>ROADMAP</u>	20
<u>FIGURE 4 NATIONAL ELECTRICITY DELIVERY TECHNOLOGIES</u>	
<u>OVERALL ROADMAP</u>	21
<u>National Electric ... (Continued)</u>	22
<u>FIGURE 5 NATIONAL ELECTRICITY DELIVERY ROADMAP FOR</u>	
<u>DEVELOPING CRITICAL TECHNOLOGIES</u>	23
<u>EARLY ADOPTERS</u>	23
<u>Southern California Edison Company</u>	23
<u>Southern California ... (Continued)</u>	24
<u>Pacific Northwest GridWise Demonstration</u>	25
<u>TXU Energy Broadband over Powerline Smart Grid</u>	26
<u>Xcel Energy Smart Grid City</u>	26
<u>ENABLING TECHNOLOGIES FOR THE SMART GRID</u>	27
<u>TABLE 2 MAJOR CLASSES OF SMART GRID ENABLING</u>	
<u>TECHNOLOGIES</u>	27
<u>COMMUNICATIONS TECHNOLOGIES</u>	27
<u>SENSING AND MEASUREMENT TECHNOLOGIES</u>	28
<u>ADVANCED COMPONENTS</u>	28
<u>CONTROL TECHNOLOGIES</u>	28
<u>INTERFACE AND DECISION SUPPORT TECHNOLOGIES</u>	29
<u>MARKET SUMMARY</u>	29
<u>TABLE 3 U.S. MARKET FOR SMART GRID TECHNOLOGIES BY TYPE</u>	
<u>OF TECHNOLOGY, THROUGH 2014 (\$ MILLIONS)</u>	29
<u>FIGURE 6 U.S. MARKET FOR SMART GRID TECHNOLOGIES, 2007-</u>	
<u>2014 (\$ MILLIONS)</u>	30
<u>FIGURE 7 U.S. SMART GRID TECHNOLOGIES MARKET SHARES,</u>	
<u>2007-2014 (\$ MILLIONS)</u>	30
<u>FIGURE 7 (CONTINUED)</u>	31
<u>CHAPTER THREE: MARKET ENVIRONMENT FOR SMART GRID</u>	
<u>ENABLING TECHNOLOGIES</u>	32
<u>LEGAL AND REGULATORY ENVIRONMENT</u>	32
<u>BARRIERS TO SMART GRID DEPLOYMENT</u>	32
<u>Federal-State Coordination</u>	32
<u>Cost Recovery</u>	32
<u>Cost Recovery (Continued)</u>	33
<u>Other Incentives to Increase Grid Efficiency</u>	34
<u>Least Cost Planning</u>	35
<u>Environmental, Public Health and Safety Impacts</u>	35
<u>Lack of Standards</u>	36
<u>LEGISLATION AND REGULATION</u>	36
<u>Federal Initiatives</u>	36
<u>Energy Policy Act of 2005</u>	36

<u>Energy Independence and Security Act of 2007</u>	37
• <u>Section 1302. Smart Grid System Report</u>	38
• <u>Section 1303. Smart Grid Advisory Committee and Smart Grid Task Force</u>	38
• <u>Section 1304. Smart Grid Technology Research, Development, and Demonstration</u>	38
• <u>Section 1305. Smart Grid Interoperability Framework</u>	39
• <u>Section 1306. Federal Matching Funds for Smart Grid Investment Costs</u>	39
• <u>Section 1307. State Consideration of Smart Grid</u>	39
• <u>Section 1308. Study of the Effect of Private Wire Laws on the Development of Combined Heat and Power Facilities</u>	39
• <u>Section 1309. DOE Study of Security Attributes of Smart Grid Systems</u>	40
<u>Emergency Economic Stabilization Act of 2008</u>	40
<u>Federal Regulation</u>	40
<u>Rulings Expanding Use of Demand Response</u>	40
<u>Assessment of Demand Response and Advanced Metering 2007</u>	41
<u>State Legislation and Regulation</u>	41
<u>Arizona</u>	41
• <u>Regulation on Time-Based Rates</u>	41
<u>California</u>	42
• <u>California Senate Bill 1438</u>	42
• <u>California Senate Bill 1491</u>	43
<u>Colorado</u>	44
• <u>House Bill 07-1037</u>	44
<u>Illinois</u>	44
• <u>Senate Bill 1592</u>	44
<u>Maryland</u>	44
• <u>EmPower Maryland Energy Efficiency Act</u>	44
<u>Massachusetts</u>	45
• <u>Green Communities Act</u>	45
<u>Michigan</u>	46
• <u>Smart Grid Collaborative</u>	46
• <u>Advanced Metering Infrastructure Standards</u>	46
<u>Oregon</u>	47
• <u>Approval of Smart Meters</u>	47
<u>Pennsylvania</u>	47

• Act 129	47
Texas	48
• Rules for Smart Metering	48
• Public Utility Commission Report on Advanced Metering	48
Vermont	48
• Energy Efficiency and Affordability Act of 2008	48
FINANCIAL AND ECONOMIC ENVIRONMENT	49
FINANCING THE SMART GRID	49
Government Funded Programs	49
Government-Funded R&D	49
• Federal R&D	49
• State-Financed R&D	50
Smart Grid Pilot and Demonstration Projects	50
Matching Grants for Smart Grid Investments	50
Capital Investments	51
• American Reinvestment and Recovery Plan of 2009	51
UTILITIES	51
Availability of Capital Funding	51
Incentives to Invest in Smart Grid Technologies	52
FIGURE 8 ANNUAL GROWTH IN U.S. ELECTRICITY CONSUMPTION, 1997-2009 (%)	53
FIGURE 9 COST OF NATURAL GAS AND FUEL OILS USED IN U.S. ELECTRIC GENERATING PLANTS, 2007-2009 (\$ PER MILLION BTUS)	54
R&D	55
CHAPTER FOUR: INTEGRATED COMMUNICATIONS FOR SMART GRIDS: TECHNOLOGIES AND MARKETS	56
SUMMARY	56
TABLE 4 U.S. MARKET FOR INTEGRATED SMART GRID COMMUNICATIONS TECHNOLOGIES, THROUGH 2014 (\$ MILLIONS)	56
FIGURE 10 TRENDS IN U.S. MARKET FOR INTEGRATED SMART GRID COMMUNICATIONS, 2007-2014 (\$ MILLIONS)	57
HOME AREA NETWORKS	57
TECHNOLOGIES	58
TABLE 5 ENABLING TECHNOLOGIES FOR SMART GRID HOME AREA NETWORKS	58
ZigBee	58
Wi-Fi	59
Z-Wave	59

<u>In-Home Powerline Communications</u>	60
<u>COMMERCIAL STATUS AND OBSTACLES TO DEPLOYMENT</u>	60
<u>TABLE 6 COMPANIES THAT MARKET OR ARE DEVELOPING COMMUNICATIONS TECHNOLOGIES FOR SMART GRID HANS</u>	61
<u>MARKETS</u>	61
<u>TABLE 7 MARKET FOR SMART GRID HAN COMMUNICATON TECHNOLOGIES, THROUGH 2014 (\$ MILLIONS)</u>	62
<u>NEIGHBORHOOD AREA NETWORKS</u>	63
<u>TECHNOLOGIES</u>	63
<u>TABLE 8 ENABLING TECHNOLOGIES FOR SMART GRID HOME AREA NETWORKS</u>	63
<u>TABLE 8 (CONTINUED)</u>	64
<u>Broadband over Power Line</u>	64
<u>Meshed Wi-Fi</u>	64
<u>ZigBee</u>	65
<u>WiMAX</u>	65
<u>Licensed Spectrum</u>	65
<u>COMMERCIAL STATUS AND OBSTACLES TO DEPLOYMENT</u>	66
<u>PROVIDERS</u>	67
<u>TABLE 9 COMPANIES THAT MARKET OR ARE DEVELOPING COMMUNICATIONS TECHNOLOGIES FOR SMART GRID NANS</u>	67
<u>MARKET</u>	67
<u>TABLE 10 MARKET FOR SMART GRID NAN COMMUNICATON TECHNOLOGIES, THROUGH 2014 (MILLION CONNECTIONS/\$ MILLIONS)</u>	68
<u>BACKBONE COMMUNICATIONS</u>	69
<u>TECHNOLOGIES</u>	69
<u>MARKETS</u>	69
<u>TABLE 11 MARKET FOR SMART GRID BACKBONE COMMUNICATON TECHNOLOGIES, THROUGH 2014 (\$ MILLIONS)</u>	70
<u>CHAPTER FIVE: SENSING AND MEASUREMENT FOR SMART GRIDS:</u>	
<u>TECHNOLOGIES AND MARKETS, 2008-2014</u>	71
<u>SUMMARY</u>	71
<u>TABLE 12 U.S. MARKET FOR SMART GRID SENSING AND MEASUREMENT TECHNOLOGIES, THROUGH 2014 (\$ MILLIONS)</u>	71
<u>FIGURE 11 TRENDS IN THE U.S. MARKET FOR SMART GRID SENSING AND MEASUREMENT, 2007-2014 (\$ MILLIONS)</u>	72
<u>SMART METERING</u>	72
<u>TECHNOLOGIES</u>	73
<u>COMMERCIAL STATUS AND BARRIERS TO DEPLOYMENT</u>	74
<u>PRODUCERS</u>	75

<u>TABLE 13 SMART METER PRODUCERS</u>	75
<u>MARKET</u>	75
<u>TABLE 14 MARKET FOR SMART METERS AND RELATED</u> <u>TECHNOLOGIES, THROUGH 2014 (\$ MILLIONS)</u>	76
<u>WIDE AREA MEASUREMENT SYSTEMS</u>	77
<u>TECHNOLOGY</u>	77
<u>COMMERCIAL STATUS AND BARRIERS TO DEPLOYMENT</u>	77
<u>PROVIDERS</u>	78
<u>TABLE 15 PROVIDERS OF TECHNOLOGIES FOR SMART GRID</u> <u>WAMS</u>	78
<u>MARKETS</u>	78
<u>TABLE 16 MARKET FOR PMUS AND RELATED WAMS</u> <u>TECHNOLOGIES, THROUGH 2014 (\$ MILLIONS)</u>	79
<u>DYNAMIC LINE RATING SENSORS</u>	80
<u>TECHNOLOGY</u>	80
<u>Online Methods</u>	80
<u>Offline Methods</u>	81
<u>COMMERCIAL STATUS AND BARRIERS TO DEPLOYMENT</u>	81
<u>PROVIDERS</u>	81
<u>TABLE 17 PROVIDERS OF TECHNOLOGIES FOR SMART GRID</u> <u>WAMS</u>	81
<u>MARKET</u>	81
<u>TABLE 18 MARKET FOR DYNAMIC LINE RATING SENSORS AND</u> <u>RELATED TECHNOLOGIES, THROUGH 2014 (\$ MILLIONS)</u>	82
<u>INSULATOR LEAKAGE SENSORS</u>	82
<u>TECHNOLOGIES</u>	82
<u>COMMERCIAL STATUS AND BARRIERS TO DEPLOYMENT</u>	83
<u>PROVIDERS</u>	83
<u>MARKET</u>	83
<u>TABLE 19 U.S. MARKET FOR REMOTE INSULATOR LEAKAGE</u> <u>CURRENT SENSORS FOR SMART GRID APPLICATIONS,</u> <u>THROUGH 2014 (\$ MILLIONS)</u>	84
<u>OTHER MONITORING SYSTEMS</u>	84
<u>TECHNOLOGIES</u>	84
<u>COMMERCIAL STATUS AND OBSTACLES TO</u> <u>DEPLOYMENT</u>	85
<u>PROVIDERS</u>	85
<u>TABLE 20 PROVIDERS OF OTHER TYPES OF SMART GRID</u> <u>SENSING AND MEASURING TECHNOLOGIES</u>	85
<u>MARKETS</u>	86
<u>TABLE 21 U.S. MARKET FOR OTHER MONITORING AND SENSING</u> <u>TECHNOLOGIES FOR SMART GRID APPLICATIONS, THROUGH</u> <u>2014 (\$ MILLIONS)</u>	86

<u>CHAPTER SIX: ADVANCED COMPONENTS FOR SMART GRIDS:</u>	
<u>TECHNOLOGIES AND MARKETS, 2008-2014</u>	87
<u>SUMMARY</u>	87
<u>TABLE 22 U.S. MARKET FOR ADVANCED SMART GRID</u>	
<u>COMPONENTS, THROUGH 2014 (\$ MILLIONS)</u>	87
<u>FIGURE 12 TRENDS IN U.S. MARKET FOR ADVANCED SMART GRID</u>	
<u>COMPONENTS, 2007-2014 (\$ MILLIONS)</u>	88
<u>POWER ELECTRONICS</u>	88
<u>TECHNOLOGIES</u>	89
<u>TABLE 23 TYPES OF POWER ELECTRONIC DEVICES</u>	89
<u>TABLE 23 (CONTINUED)</u>	90
<u>COMMERCIAL STATUS AND OBSTACLES TO</u>	
<u>DEPLOYMENT</u>	90
<u>PROVIDERS</u>	90
<u>TABLE 24 PROVIDERS OF POWER ELECTRONICS DEVICES FOR</u>	
<u>SMART GRID APPLICATIONS</u>	90
<u>MARKETS</u>	91
<u>TABLE 25 U.S. POWER ELECTRONICS MARKET FOR SMART GRID</u>	
<u>APPLICATIONS, THROUGH 2014 (\$ MILLIONS)</u>	91
<u>FAULT CURRENT LIMITERS</u>	91
<u>TECHNOLOGY</u>	92
<u>Resistive FCLs</u>	93
<u>Inductive FCLs</u>	93
<u>COMMERCIAL STATUS AND OBSTACLES TO</u>	
<u>DEPLOYMENT</u>	93
<u>PROVIDERS</u>	94
<u>TABLE 26 SUPPLIERS OF FAULT CURRENT LIMITERS</u>	94
<u>MARKET</u>	94
<u>TABLE 27 U.S. ELECTIC UTILITY MARKET FOR FAULT CURRENT</u>	
<u>LIMITERS, THROUGH 2014 (\$ MILLIONS)</u>	95
<u>HIGH-CAPACITY TRANSMISSION CABLE</u>	95
<u>TECHNOLOGIES</u>	95
<u>Superconducting Cable</u>	95
<u>Superconducting Cable (Continued)</u>	96
<u>High Capacity Overhead Conductor Cable</u>	97
<u>Aluminum Conductor Composite Core Cable</u>	97
<u>Aluminum Conductor Composite Reinforced Cable</u>	97
<u>Annealed Aluminum, Steel-Supported Trapezoidal</u>	
<u>Cross Section Conductor Wire</u>	98
<u>COMMERCIAL STATUS AND BARRIERS TO DEPLOYMENT</u>	98
<u>PROVIDERS</u>	99
<u>TABLE 28 PROVIDERS OF HIGH-CAPACITY TRANSMISSION CABLE</u>	
<u>FOR THE SMART GRID</u>	99
<u>MARKET</u>	100

<u>TABLE 29 MARKET FOR ADVANCED ELECTRIC TRANSMISSION CABLE, THROUGH 2014 (\$ MILLIONS)</u>	100
<u>Superconducting Cable</u>	100
<u>TABLE 30 MARKET FOR SUPERCONDUCTING ELECTRIC TRANSMISSION CABLE, THROUGH 2014 (\$ MILLIONS)</u>	100
<u>High Capacity Overhead Conductor Cable</u>	101
<u>TABLE 31 MARKET FOR HIGH-CAPACITY OVERHEAD CONDUCTOR CABLE, 2007 THROUGH 2014 (\$ MILLIONS)</u>	101
<u>Aluminum Conductor Composite Core Cable</u>	102
<u>Aluminum Conductor Composite Reinforced Cable</u>	102
<u>Annealed Aluminum, Steel-Supported Trapezoidal Cross Section Conductor Wire</u>	103
<u>DISTRIBUTED ENERGY RESOURCES</u>	103
<u>TABLE 32 MARKET FOR DISTRIBUTED GENERATION AND POWER STORAGE SYSTEMS, THROUGH 2014 (\$ MILLIONS)</u>	103
<u>DISTRIBUTED GENERATION DEVICES</u>	103
<u>Technologies</u>	104
<u>Photovoltaics</u>	104
<u>TABLE 33 MAJOR PHOTOVOLTAIC TECHNOLOGIES</u>	104
<u>TABLE 33 (CONTINUED)</u>	105
<u>Wind Turbine</u>	105
<u>Microturbines</u>	106
<u>Fuel Cells</u>	106
<u>TABLE 34 MAJOR FUEL CELL TECHNOLOGIES</u>	107
<u>Providers</u>	107
<u>TABLE 35 PROVIDERS OF DISTRIBUTED GENERATION EQUIPMENT</u>	107
<u>TABLE 35 (CONTINUED)</u>	108
<u>Markets</u>	108
<u>TABLE 36 MARKET FOR DISTRIBUTED GENERATION SYSTEMS, THROUGH 2014 (\$ MILLIONS)</u>	109
<u>Photovoltaics</u>	109
<u>TABLE 37 PROJECTED U.S. CONSUMPTION OF PHOTOVOLTAICS, THROUGH 2014 (MW)</u>	109
<u>TABLE 38 PROJECTED U.S. MARKET FOR GRID-CONNECTED PHOTOVOLTAICS, THROUGH 2014 (\$ MILLIONS)</u>	110
<u>Wind Turbines</u>	110
<u>TABLE 39 PROJECTED U.S. MARKET FOR WIND TURBINES, THROUGH 2014 (GW/\$ MILLIONS)</u>	111
<u>TABLE 40 PROJECTED U.S. MARKET FOR GRID-CONNECTED WIND TURBINES, THROUGH 2014 (\$ MILLIONS)</u>	112
<u>Fuel Cells</u>	112
<u>TABLE 41 U.S. FUEL CELL MARKET BY TECHNOLOGY TYPE, THROUGH 2014 (\$ MILLIONS)</u>	112

Microturbines	113
<u>TABLE 42 PROJECTED U.S. MARKET FOR GRID-CONNECTED MICROTURBINES, THROUGH 2014 (\$ MILLIONS)</u>	113
<u>DISTRIBUTED STORAGE SYSTEMS</u>	114
<u>Technologies</u>	114
<u>Sodium-Sulfur Batteries</u>	114
<u>Vanadium Redox Batteries</u>	115
<u>Supercapacitors</u>	116
<u>Superconducting Power Storage</u>	117
• <u>Superconducting Magnetic Energy Storage</u>	117
• <u>Superconducting Flywheel Energy Storage</u>	117
<u>Compressed Air Storage</u>	118
<u>Plug-In Hybrid Vehicles</u>	118
<u>Plug-In ... (Continued)</u>	119
<u>Providers</u>	120
<u>TABLE 43 PROVIDERS OF DISTRIBUTED STORAGE EQUIPMENT</u>	120
<u>TABLE 43 (CONTINUED)</u>	121
<u>Markets</u>	121
<u>TABLE 44 MARKET FOR DISTRIBUTED STORAGE SYSTEMS, THROUGH 2014 (\$ MILLIONS)</u>	121
<u>NaS Batteries</u>	122
<u>TABLE 45 U.S. MARKET FOR NAS BATTERY POWER STORAGE SYSTEMS, THROUGH 2014 (\$ MILLIONS)</u>	122
<u>Vanadium Redox Batteries</u>	122
<u>TABLE 46 U.S. MARKET FOR VANADIUM REDOX BATTERY DISTRIBUTED POWER STORAGE SYSTEMS, THROUGH 2014 (\$ MILLIONS)</u>	123
<u>Superconducting Magnetic and Flywheel Storage</u>	123
<u>TABLE 47 U.S. MARKET FOR SUPERCONDUCTING POWER STORAGE SYSTEMS, THROUGH 2014 (\$ MILLIONS)</u>	123
<u>Supercapacitors</u>	124
<u>TABLE 48 U.S. MARKET FOR SUPERCAPACITOR STORAGE SYSTEMS, THROUGH 2014 (\$MILLIONS)</u>	124
<u>Compressed Air Storage</u>	124
<u>TABLE 49 U.S. MARKET FOR COMPRESSED AIR STORAGE SYSTEMS, THROUGH 2014 (\$ MILLIONS)</u>	125
<u>Plug-In Hybrid Storage</u>	125
<u>TABLE 50 U.S. MARKET FOR GRID CONNECTED PHEVS, THROUGH 2014 (NUMBER OF VEHICLES/\$ MILLIONS)</u>	125
<u>Plug-In Hybrid Storage (Continued)</u>	126
 <u>CHAPTER SEVEN: ADVANCED CONTROLS FOR SMART GRIDS: TECHNOLOGIES AND MARKETS, 2007-2014</u>	127
<u>SUMMARY</u>	127

<u>TABLE 51 U.S. MARKET FOR ADVANCED SMART GRID CONTROL TECHNOLOGIES, THROUGH 2014 (\$ MILLIONS)</u>	127
<u>FIGURE 13 TRENDS IN THE U.S. MARKET FOR ADVANCED SMART GRID COMPONENTS, 2007-2014 (\$ MILLIONS)</u>	128
<u>DISTRIBUTED INTELLIGENT AGENTS TECHNOLOGIES</u>	128
<u>Digital Protective Relays</u>	129
<u>Intelligent Tap Changers</u>	129
<u>Dynamic Circuit Rating Tools</u>	129
<u>Distributed Energy Management Systems</u>	130
<u>Grid-Friendly Appliance Controllers</u>	130
<u>Dynamic Distributed Power Flow Controllers</u>	131
<u>PRODUCERS AND DEVELOPERS</u>	131
<u>TABLE 52 PROVIDERS OF DISTRIBUTED INTELLIGENT AGENTS MARKET</u>	132
<u>TABLE 53 MARKET FOR DISTRIBUTED INTELLIGENT AGENTS, THROUGH 2014 (\$ MILLIONS)</u>	132
<u>Digital Protective Relays</u>	133
<u>TABLE 54 MARKET FOR DIGITAL PROTECTIVE RELAYS, THROUGH 2014 (\$ MILLIONS)</u>	133
<u>Intelligent Tap Changers</u>	133
<u>TABLE 55 MARKET FOR INTELLIGENT TAP CHANGERS, THROUGH 2014 (\$MILLIONS)</u>	133
<u>Energy Management Systems</u>	134
<u>TABLE 56 MARKET FOR DISTRIBUTED ENERGY MANAGEMENT SYSTEMS, THROUGH 2014 (\$ MILLIONS)</u>	134
<u>Grid Friendly Appliance Controllers</u>	135
<u>TABLE 57 MARKET FOR GRID-FRIENDLY APPLIANCE CONTROLLERS, THROUGH 2014 (\$ MILLIONS)</u>	135
<u>Distributed Power Flow Controllers</u>	135
<u>TABLE 58 MARKET FOR DISTRIBUTED POWER FLOW CONTROLLERS, THROUGH 2014 (\$ MILLIONS)</u>	136
<u>HIGH PERFORMANCE COMPUTING TECHNOLOGIES</u>	136
<u>Technologies (Continued)</u>	137
<u>MARKETS</u>	138
<u>TABLE 59 MARKET FOR SMART GRID-RELATED DISTRIBUTED COMPUTING TECHNOLOGIES, THROUGH 2014 (\$ MILLIONS)</u>	138
<u>CENTRALIZED CONTROL APPLICATIONS TECHNOLOGIES</u>	138
<u>TABLE 60 CENTRALIZED APPLICATIONS FOR THE SMART GRID</u>	139
<u>TABLE 60 (CONTINUED) PROVIDERS</u>	140

<u>TABLE 61 PROVIDERS OF CENTRALIZED SMART GRID CONTROL APPLICATIONS</u>	141
<u>MARKETS</u>	141
<u>TABLE 62 MARKET FOR CENTRALIZED SMART GRID CONTROL APPLICATIONS, THROUGH 2014 (\$ MILLIONS)</u>	141
<u>INTERFACES AND DECISION SUPPORT SYSTEMS</u>	142
<u>TECHNOLOGIES</u>	142
<u>TABLE 63 INTERFACE AND DECISION SUPPORT TECHNOLOGIES FOR THE SMART GRID</u>	142
<u>PRODUCERS AND DEVELOPERS</u>	143
<u>TABLE 64 PROVIDERS OF INTERFACE AND DECISION SUPPORT TECHNOLOGIES FOR SMART GRID APPLICATIONS</u>	143
<u>MARKET</u>	143
<u>TABLE 65 MARKET FOR INTERFACE AND DECISION SUPPORT TECHNOLOGIES FOR SMART GRID APPLICATIONS, THROUGH 2014 (\$ MILLIONS)</u>	144
<u>APPENDIX A: COMPANY PROFILES</u>	145
<u>INTEGRATED COMMUNICATIONS</u>	145
<u>ALVARION, INC.</u>	145
<u>AMBIENT CORP.</u>	145
<u>AMPERION, INC.</u>	145
<u>ARCADIAN NETWORKS, INC.</u>	146
<u>ARKADOS, INC.</u>	146
<u>CURRENT GROUP, LLC</u>	146
<u>EMBER CORP.</u>	147
<u>GAINSPAN CORP.</u>	147
<u>GRIDNET, INC.</u>	148
<u>INTERNATIONAL BROADBAND ELECTRIC COMMUNICATIONS, INC.</u>	149
<u>MAIN.NET POWER LINE COMMUNICATIONS, INC.</u>	149
<u>MMB RESEARCH, INC.</u>	150
<u>RUGGEDCOM INC.</u>	150
<u>SMARTSYNCH</u>	151
<u>TELKONET, INC.</u>	151
<u>ZENSY INC.</u>	151
<u>SMART GRID SENSING AND MEASUREMENT TECHNOLOGIES</u>	152
<u>SMART METERS</u>	152
<u>Echelon Corp.</u>	152
<u>Elster LLC</u>	152
<u>eMeter Corp.</u>	153
<u>EnergyICT Inc.</u>	153
<u>Itron, Inc.</u>	153
<u>Landis+Gyr AG</u>	154
<u>Sensus Metering Systems</u>	154

<u>Trilliant Networks</u>	154
<u>WIRE AREA MEASUREMENT SYSTEMS</u>	155
<u>Doubletree Systems, Inc.</u>	155
<u>Macrodyne, Inc.</u>	155
<u>PowerWorld Corp.</u>	155
<u>DYNAMIC LINE RATING</u>	156
<u>Electrotech, Inc.</u>	156
<u>Shaw Energy Delivery Services, Inc.</u>	156
<u>The Valley Group, Inc.</u>	156
<u>USi Power</u>	157
<u>INSULATOR CURRENT LEAKAGE SENSORS</u>	157
<u>PSP Technologies, Inc.</u>	157
<u>Telepathx</u>	157
<u>OTHER SENSORS</u>	158
<u>FISO</u>	158
<u>Intelligent Controls, Inc.</u>	158
<u>ADVANCED COMPONENTS</u>	159
<u>POWER ELECTRONICS</u>	159
<u>Satcon Technology Corporation</u>	159
<u>Xantrex Technology Inc.</u>	159
<u>FAULT CURRENT LIMITERS</u>	159
<u>Nexans</u>	159
<u>Superpower Inc.</u>	160
<u>Zenergy Power plc</u>	160
<u>TRANSMISSION CABLE</u>	160
<u>American Superconductor Corp.</u>	160
<u>Composite Technology Corp.</u>	161
<u>Comverge, Inc.</u>	161
<u>EnerNOC, Inc.</u>	162
<u>Hyper Tech Research, Inc.</u>	163
<u>Metal Oxide Technologies Inc.</u>	163
<u>3M Company</u>	164
<u>Southwire Co.</u>	164
<u>DISTRIBUTED GENERATION</u>	165
<u>MICROTURBINES</u>	165
<u>Capstone Turbine Corp.</u>	165
<u>PHOTOVOLTAICS</u>	165
<u>BP Solar International LLC</u>	165
<u>First Solar LLC</u>	165
<u>HelioVolt Corp.</u>	166
<u>Konarka Technologies, Inc.</u>	166
<u>FUEL CELLS</u>	167
<u>Fuel Cell Energy, Inc.</u>	167
<u>Materials and Systems Research, Inc.</u>	167

<u>DISTRIBUTED STORAGE</u>	168
<u>Accel Instruments Gmbh</u>	168
<u>Maxwell Technologies, Inc.</u>	168
<u>NGK Insulators, Ltd.</u>	168
<u>V2Green</u>	169
<u>VRB Power Systems Inc.</u>	169
<u>SMART GRID CONTROLS</u>	170
<u>DISTRIBUTED INTELLIGENT AGENTS</u>	170
<u>BPL GLOBAL, LTD.</u>	170
<u>GridPoint, Inc.</u>	170
<u>CENTRALIZED CONTROL APPLICATIONS</u>	171
<u>Intergraph Corp.</u>	171
<u>Milsoft Utility Solutions</u>	171
<u>INTERFACE AND DECISION SUPPORT</u>	172
<u>Space-Time-Insight</u>	172
<u>APPENDIX B: PATENT ANALYSIS</u>	173
<u>TABLE 66 NUMBER OF U.S. SMART GRID-RELATED PATENTS BY</u> <u>TYPE OF TECHNOLOGY</u>	173
<u>FIGURE 14 U.S. SMART GRID-RELATED PATENTS BY TYPE OF</u> <u>TECHNOLOGY, AS OF FEBRUARY 13, 2009 (%)</u>	174