

CHAPTER ONE: INTRODUCTION.....	1
STUDY BACKGROUND	1
GOALS AND OBJECTIVES.....	2
INTENDED AUDIENCE.....	3
SCOPE OF REPORT	4
METHODOLOGY	4
AUTHOR’S CREDENTIALS	5
RELATED BCC RESEARCH	5
BCC ONLINE SERVICES.....	6
DISCLAIMER	6
 CHAPTER TWO: EXECUTIVE SUMMARY.....	 7
<i>SUMMARY TABLE U.S. MARKET FOR SMART GRID</i> <i>TECHNOLOGIES, THROUGH 2016 (\$ MILLIONS)</i>	 7
<i>SUMMARY FIGURE U.S. MARKET FOR SMART GRID</i> <i>TECHNOLOGIES, 2010–2016 (\$ MILLIONS)</i>	 8
 CHAPTER THREE: OVERVIEW OF “SMART GRIDS”	 9
DEFINITIONS	9
BENEFITS OF SMART GRIDS	9
DIRECT BENEFITS	9
Benefits to Utilities	9
Lower Capital Costs.....	9
Reduced Operating Costs	10
Benefits to Users.....	11
Improved Quality and Reliability	11
Lower Costs.....	11
<i>FIGURE 1 AVERAGE RETAIL PRICE OF ELECTRICITY, 2000–2010</i> <i>(CENTS/KWH)</i>	 12
Greater Consumer Choice	12
INDIRECT BENEFITS.....	13
Reduced Consumption of Fossil Fuels	13
<i>FIGURE 2 U.S. ELECTRICITY GENERATION BY FUEL TYPE, 2009</i> <i>(%)</i>	 14
<i>TABLE 1 U.S. CONSUMPTION OF FOSSIL FUELS FOR</i> <i>ELECTRICITY GENERATION, THROUGH 2009</i>	 15
Improved Balance of Payments Position	15
<i>FIGURE 3 U.S. FOSSIL FUEL IMPORTS, 2009 (PERCENT OF TOTAL</i> <i>FOSSIL FUEL IMPORTS)</i>	 16
Enhanced National Security	17
Job Creation.....	17
Economic Development	18
Environmental Benefits	18
THE PATH TO A SMART GRID.....	19

GRID 2030	19
National Electricity “Backbone”	20
Regional Interconnections.....	20
Local Distribution, Mini- and Micro-Grids.....	21
NATIONAL ELECTRIC DELIVERY TECHNOLOGIES	
ROADMAP	21
<i>FIGURE 4 NATIONAL ELECTRICITY DELIVERY TECHNOLOGIES</i>	
OVERALL ROADMAP.....	22
National Electric Delivery ... (Continued)	23
<i>FIGURE 5 NATIONAL ELECTRICITY DELIVERY ROADMAP FOR</i>	
<i>DEVELOPING CRITICAL TECHNOLOGIES.....</i>	24
EARLY ADOPTERS.....	24
Southern California Edison Company.....	25
Southern California ... (Continued)	25
Pacific Northwest Smart Grid Demonstration Project	26
TXU Energy Broadband over Power Line Smart Grid	27
Xcel Energy Smart Grid City	28
Austin Energy Smart Grid Program.....	29
Other Projects	29
ENABLING TECHNOLOGIES FOR THE SMART GRID	30
<i>TABLE 2 MAJOR CLASSES OF SMART GRID-ENABLING</i>	
<i>TECHNOLOGIES.....</i>	30
COMMUNICATIONS TECHNOLOGIES.....	30
SENSING AND MEASUREMENT TECHNOLOGIES.....	31
ADVANCED COMPONENTS	31
CONTROL TECHNOLOGIES.....	31
INTERFACE AND DECISION-SUPPORT TECHNOLOGIES	32
MARKET SUMMARY.....	32
<i>TABLE 3 U.S. MARKET FOR SMART GRID TECHNOLOGIES BY TYPE</i>	
<i>OF TECHNOLOGY, 2010 THROUGH 2016 (\$ MILLIONS).....</i>	32
<i>FIGURE 6 U.S. MARKET FOR SMART GRID TECHNOLOGIES, 2010-</i>	
<i>2016 (\$ MILLIONS).....</i>	33
<i>FIGURE 7 U.S. SMART GRID TECHNOLOGIES MARKET SHARES,</i>	
<i>2010-2016 (%)</i>	34
CHAPTER FOUR: MARKET ENVIRONMENT FOR SMART GRID-	
ENABLING TECHNOLOGIES	35
LEGAL AND REGULATORY ENVIRONMENT	35
BARRIERS TO SMART GRID DEPLOYMENT	35
Federal-State Coordination.....	35
Cost Recovery.....	35
Cost Recovery (Continued)	36
Other Incentives to Increase Grid Efficiency	37
Least Cost Planning	37
Environmental, Public Health and Safety Impacts	38

Lack of Standards.....	38
LEGISLATION AND REGULATION	39
Federal Initiatives	39
Energy Policy Act of 2005.....	39
Energy Independence and Security Act of 2007	40
Section 1301. Statement of Policy on Modernization of Electricity Grid	40
Section 1302. Smart Grid System Report.....	41
Section 1303. Smart Grid Advisory Committee and Smart Grid Task Force.....	41
Section 1304. Smart Grid Technology Research, Development, and Demonstration	41
Section 1305. Smart Grid Interoperability Framework.....	42
Section 1306. Federal Matching Funds for Smart Grid Investment Costs	42
Section 1307. State Consideration of Smart Grid.....	42
Section 1308. Study of the Effect of Private Wire Laws on the Development of Combined Heat and Power Facilities	42
Section 1309. DOE Study of Security Attributes of Smart Grid Systems	43
Emergency Economic Stabilization Act of 2008	43
American Recovery and Reinvestment Act of 2009	43
Federal Regulation	44
Rulings Expanding Use of Demand Response.....	44
Assessment of Demand Response and Advanced Metering.....	45
Interim Rate Policy.....	45
Smart Grid Standards	45
State Legislation and Regulation	46
Arizona	46
Regulation on Time-Based Rates.....	46
California.....	47
California Senate Bill 17	47
California Senate Bill 1491	48
Colorado.....	49
House Bill 07-1037.....	49
Illinois.....	49
Senate Bill 1592	49
Maryland	49
EmPower Maryland Energy Efficiency Act	49

Massachusetts.....	50
Green Communities Act	50
Michigan.....	51
Legislative Activities	51
Smart Grid Collaborative.....	51
Advanced Metering Infrastructure Standards.....	51
New Jersey	52
New Jersey Demand Response Working Group.....	52
Oregon	52
Approval of Smart Meters	52
Pennsylvania	52
Act 129	52
Texas	53
SB 3693	53
Rules for Smart Metering.....	53
Public Utility Commission Report on Advanced Metering	54
Vermont.....	54
Energy Efficiency and Affordability Act of 2008	54
Collaborative Smart Grid Pilot Program	54
FINANCIAL AND ECONOMIC ENVIRONMENT.....	55
FINANCING THE SMART GRID	55
Government-Funded Programs	55
Government-Funded R&D.....	55
Federal R&D.....	55
State-Financed R&D.....	56
Smart Grid Pilot and Demonstration Projects	56
Matching Grants for Smart Grid Investments.....	56
Capital Investments	56
American Reinvestment and Recovery Plan of 2009	56
UTILITIES	57
R&D	57
R&D (Continued).....	58
CHAPTER FIVE: INTEGRATED COMMUNICATIONS FOR SMART GRIDS: TECHNOLOGIES AND MARKETS.....	59
SUMMARY.....	59
<i>TABLE 4 U.S. MARKET FOR INTEGRATED SMART GRID COMMUNICATIONS TECHNOLOGIES, THROUGH 2016 (\$ MILLIONS)</i>	59
<i>FIGURE 8 TRENDS IN U.S. MARKET FOR INTEGRATED SMART GRID COMMUNICATIONS, 2010–2016 (\$ MILLIONS)</i>	60

HOME AREA NETWORKS.....	60
TECHNOLOGIES	61
<i>TABLE 5 ENABLING TECHNOLOGIES FOR SMART GRID HOME</i>	
<i>AREA NETWORKS</i>	61
ZigBee.....	61
Wi-Fi.....	62
Z-Wave	62
In-Home Power Line Communications.....	63
COMMERCIAL STATUS AND OBSTACLES TO	
DEPLOYMENT.....	63
PRODUCERS AND DEVELOPERS.....	64
<i>TABLE 6 COMPANIES THAT MARKET OR ARE DEVELOPING</i>	
<i>COMMUNICATIONS TECHNOLOGIES FOR SMART GRID HANS</i>	64
MARKETS	64
<i>TABLE 7 MARKET FOR SMART GRID HAN COMMUNICATION</i>	
<i>TECHNOLOGIES, THROUGH 2016 (\$ MILLIONS/MILLION UNITS)</i>	65
NEIGHBORHOOD AREA NETWORKS	65
TECHNOLOGIES	66
<i>TABLE 8 ENABLING TECHNOLOGIES FOR SMART GRID</i>	
<i>NEIGHBORHOOD AREA NETWORKS</i>	66
Broadband over Power Line.....	67
Meshed Wi-Fi.....	67
ZigBee.....	67
WiMAX.....	68
Licensed Spectrum	68
COMMERCIAL STATUS AND OBSTACLES TO	
DEPLOYMENT.....	68
Commercial Status and Obstacles ... (Continued).....	69
PROVIDERS.....	70
<i>TABLE 9 COMPANIES THAT MARKET OR ARE DEVELOPING</i>	
<i>COMMUNICATIONS TECHNOLOGIES FOR SMART GRID NANS</i>	70
MARKET	70
<i>TABLE 10 MARKET FOR SMART GRID NAN COMMUNICATON</i>	
<i>TECHNOLOGIES, THROUGH 2016 (MILLION CONNECTIONS/\$</i>	
<i>MILLIONS)</i>	71
BACKBONE COMMUNICATIONS.....	71
TECHNOLOGIES	71
MARKETS	72
<i>TABLE 11 MARKET FOR SMART GRID BACKBONE</i>	
<i>COMMUNICATON TECHNOLOGIES, THROUGH 2016 (\$</i>	
<i>MILLIONS)</i>	72
CHAPTER SIX: SENSING AND MEASUREMENT FOR SMART GRIDS:	
TECHNOLOGIES AND MARKETS.....	73
SUMMARY.....	73

<i>TABLE 12 U.S. MARKET FOR SMART GRID SENSING AND MEASUREMENT TECHNOLOGIES, THROUGH 2016 (\$ MILLIONS)</i>	73
<i>FIGURE 9 TRENDS IN THE U.S. MARKET FOR SMART GRID SENSING AND MEASUREMENT, 2010–2016 (\$ MILLIONS)</i>	74
SMART METERING.....	74
TECHNOLOGIES	75
COMMERCIAL STATUS AND BARRIERS TO DEPLOYMENT	76
PRODUCERS	77
<i>TABLE 13 SMART METER PRODUCERS</i>	77
MARKET	78
<i>TABLE 14 MARKET FOR SMART METERS AND RELATED TECHNOLOGIES, THROUGH 2016 (\$ MILLIONS)</i>	78
WIDE-AREA MEASUREMENT SYSTEMS.....	78
TECHNOLOGY	79
COMMERCIAL STATUS AND BARRIERS TO DEPLOYMENT	79
PROVIDERS.....	80
<i>TABLE 15 PROVIDERS OF TECHNOLOGIES FOR SMART GRID WAMS</i>	80
MARKETS	80
<i>TABLE 16 MARKET FOR PMUS AND RELATED WAMS TECHNOLOGIES, THROUGH 2016 (\$ MILLIONS)</i>	81
DYNAMIC LINE-RATING SENSORS	82
TECHNOLOGY	82
Online Methods.....	82
Offline Methods	83
COMMERCIAL STATUS AND BARRIERS TO DEPLOYMENT	83
PROVIDERS.....	83
<i>TABLE 17 PROVIDERS OF TECHNOLOGIES FOR SMART GRID WAMS</i>	83
MARKET	83
<i>TABLE 18 MARKET FOR DYNAMIC LINE-RATING SENSORS AND RELATED TECHNOLOGIES, THROUGH 2016 (\$ MILLIONS)</i>	84
INSULATOR LEAKAGE SENSORS	84
TECHNOLOGIES	84
COMMERCIAL STATUS AND BARRIERS TO DEPLOYMENT	85
PROVIDERS.....	85
MARKET	85
<i>TABLE 19 U.S. MARKET FOR REMOTE INSULATOR LEAKAGE CURRENT SENSORS FOR SMART GRID APPLICATIONS, THROUGH 2016 (\$ MILLIONS)</i>	86
OTHER MONITORING SYSTEMS	86
TECHNOLOGIES	86
COMMERCIAL STATUS AND OBSTACLES TO DEPLOYMENT.....	87

PROVIDERS.....	87
TABLE 20 PROVIDERS OF OTHER TYPES OF SMART GRID SENSING AND MEASURING TECHNOLOGIES.....	87
MARKETS	88
TABLE 21 U.S. MARKET FOR OTHER MONITORING AND SENSING TECHNOLOGIES FOR SMART GRID APPLICATIONS, THROUGH 2016 (\$ MILLIONS).....	88
CHAPTER SEVEN: ADVANCED COMPONENTS FOR SMART GRIDS:	
TECHNOLOGIES AND MARKETS.....	89
SUMMARY.....	89
TABLE 22 U.S. MARKET FOR ADVANCED SMART GRID COMPONENTS, THROUGH 2016 (\$ MILLIONS)	89
FIGURE 10 TRENDS IN U.S. MARKET FOR ADVANCED SMART GRID COMPONENTS, 2010–2016 (\$ MILLIONS)	90
POWER ELECTRONICS	90
TECHNOLOGIES	91
TABLE 23 TYPES OF POWER ELECTRONIC DEVICES.....	91
TABLE 23 (CONTINUED).....	92
COMMERCIAL STATUS AND OBSTACLES TO DEPLOYMENT.....	92
PROVIDERS.....	92
TABLE 24 PROVIDERS OF POWER ELECTRONICS DEVICES FOR SMART GRID APPLICATIONS	92
MARKETS	93
TABLE 25 U.S. POWER ELECTRONICS MARKET FOR SMART GRID APPLICATIONS, THROUGH 2016 (\$ MILLIONS)	93
FAULT CURRENT LIMITERS.....	93
TECHNOLOGY.....	94
Resistive FCLs.....	95
Inductive FCLs	95
COMMERCIAL STATUS AND OBSTACLES TO DEPLOYMENT.....	95
PROVIDERS.....	96
TABLE 26 SUPPLIERS OF FAULT CURRENT LIMITERS.....	96
MARKET	96
TABLE 27 U.S. ELECTRIC UTILITY MARKET FOR FAULT CURRENT LIMITERS, THROUGH 2016 (\$ MILLIONS).....	97
HIGH-CAPACITY TRANSMISSION CABLE	97
TECHNOLOGIES	97
Superconducting Cable.....	97
Superconducting Cable (Continued)	98
High-Capacity Overhead Conductor Cable	99
Aluminum-Conductor Composite Core Cable.....	99
Aluminum-Conductor Composite Reinforced Cable.....	99

Annealed Aluminum, Steel-Supported Trapezoidal Cross-Section Conductor Wire	100
COMMERCIAL STATUS AND BARRIERS TO DEPLOYMENT	100
PROVIDERS.....	101
<i>TABLE 28 PROVIDERS OF HIGH-CAPACITY TRANSMISSION CABLE FOR THE SMART GRID.....</i>	<i>101</i>
MARKET	102
<i>TABLE 29 MARKET FOR ADVANCED ELECTRIC TRANSMISSION CABLE, THROUGH 2016 (\$ MILLIONS).....</i>	<i>102</i>
Superconducting Cable.....	102
<i>TABLE 30 MARKET FOR SUPERCONDUCTING ELECTRIC TRANSMISSION CABLE, THROUGH 2016 (\$ MILLIONS)</i>	<i>102</i>
High-Capacity Overhead Conductor Cable	103
<i>TABLE 31 MARKET FOR HIGH-CAPACITY OVERHEAD CONDUCTOR CABLE, THROUGH 2016 (\$ MILLIONS).....</i>	<i>103</i>
Aluminum-Conductor Composite Core Cable.....	104
Aluminum-Conductor Composite Reinforced Cable.....	104
Annealed Aluminum, Steel-Supported Trapezoidal Cross-Section Conductor Wire	104
DISTRIBUTED ENERGY RESOURCES	105
<i>TABLE 32 MARKET FOR DISTRIBUTED GENERATION AND POWER STORAGE SYSTEMS, THROUGH 2016 (\$ MILLIONS)</i>	<i>105</i>
DISTRIBUTED GENERATION DEVICES	105
Technologies.....	106
Photovoltaics	106
<i>TABLE 33 MAJOR PHOTOVOLTAIC TECHNOLOGIES</i>	<i>106</i>
Wind Turbine	107
Microturbines.....	107
Fuel Cells	108
<i>TABLE 34 MAJOR FUEL CELL TECHNOLOGIES</i>	<i>109</i>
Providers	109
<i>TABLE 35 PROVIDERS OF DISTRIBUTED GENERATION EQUIPMENT.....</i>	<i>109</i>
<i>TABLE 35 (CONTINUED).....</i>	<i>110</i>
Markets	110
<i>TABLE 36 MARKET FOR DISTRIBUTED GENERATION SYSTEMS, THROUGH 2016 (\$ MILLIONS).....</i>	<i>110</i>
Photovoltaics	111
<i>TABLE 37 PROJECTED U.S. CONSUMPTION OF PHOTOVOLTAICS, THROUGH 2016 (MW/\$ MILLION).....</i>	<i>111</i>
<i>TABLE 38 PROJECTED U.S. MARKET FOR GRID-CONNECTED PHOTOVOLTAICS, 2010 THROUGH 2016 (\$ MILLIONS).....</i>	<i>111</i>
Wind Turbines	112

<i>TABLE 39 PROJECTED U.S. MARKET FOR WIND TURBINES, THROUGH 2016 (GW/\$ MILLIONS)</i>	112
Fuel Cells	113
<i>TABLE 40 U.S. FUEL CELL MARKET BY TECHNOLOGY TYPE, THROUGH 2016 (\$ MILLIONS)</i>	113
Microturbines	113
<i>TABLE 41 PROJECTED U.S. MARKET FOR GRID-CONNECTED MICROTURBINES, THROUGH 2016 (\$ MILLIONS)</i>	114
DISTRIBUTED STORAGE SYSTEMS	114
Technologies.....	114
Sodium-Sulfur Batteries.....	115
Vanadium Redox Batteries.....	116
Supercapacitors.....	117
Superconducting Power Storage	117
Superconducting Magnetic Energy Storage	118
Superconducting Flywheel Energy Storage.....	118
Compressed-Air Energy Storage	119
Plug-In Hybrid and All-Electric Vehicles	119
Plug-In Hybrid and ... (Continued)	120
Providers	121
<i>TABLE 42 PROVIDERS OF DISTRIBUTED STORAGE EQUIPMENT</i>	122
Markets	122
<i>TABLE 43 MARKET FOR DISTRIBUTED STORAGE SYSTEMS, THROUGH 2016 (\$ MILLIONS)</i>	123
NaS Batteries	123
<i>TABLE 44 U.S. MARKET FOR NAS BATTERY POWER STORAGE SYSTEMS, THROUGH 2016 (\$ MILLIONS)</i>	123
Vanadium Redox Batteries.....	124
<i>TABLE 45 U.S. MARKET FOR VANADIUM REDOX BATTERY DISTRIBUTED POWER STORAGE SYSTEMS, THROUGH 2016 (\$ MILLIONS)</i>	124
Superconducting Magnetic and Flywheel Storage	124
<i>TABLE 46 U.S. MARKET FOR SUPERCONDUCTING POWER STORAGE SYSTEMS, THROUGH 2016 (\$ MILLIONS)</i>	125
Supercapacitors.....	125
<i>TABLE 47 U.S. MARKET FOR SUPERCAPACITOR STORAGE SYSTEMS, THROUGH 2016 (\$ MILLIONS)</i>	125
Compressed-Air Storage	125
<i>TABLE 48 U.S. MARKET FOR COMPRESSED AIR STORAGE SYSTEMS, THROUGH 2016 (\$ MILLIONS)</i>	126
Plug-In Hybrid and All-Electric Vehicle Storage	126
<i>TABLE 49 U.S. MARKET FOR GRID-CONNECTED PHEVS, THROUGH 2016 (NUMBER OF VEHICLES/\$ MILLIONS)</i>	127

CHAPTER EIGHT: ADVANCED CONTROLS FOR SMART GRIDS:	
TECHNOLOGIES AND MARKETS.....	128
SUMMARY.....	128
TABLE 50 U.S. MARKET FOR ADVANCED SMART GRID CONTROL	
TECHNOLOGIES, THROUGH 2016 (\$ MILLIONS).....	128
FIGURE 11 TRENDS IN THE U.S. MARKET FOR ADVANCED SMART	
GRID COMPONENTS, 2010–2016 (\$ MILLIONS).....	129
DISTRIBUTED INTELLIGENT AGENTS.....	129
TECHNOLOGIES	129
Digital Protective Relays.....	130
Intelligent Tap Changers	130
Dynamic Circuit-Rating Tools.....	130
Distributed Energy Management Systems	131
Grid-Friendly Appliance Controllers	131
Dynamic Distributed Power Flow Controllers	132
PRODUCERS AND DEVELOPERS.....	132
TABLE 51 PROVIDERS OF DISTRIBUTED INTELLIGENT AGENTS.....	133
MARKET	133
TABLE 52 MARKET FOR DISTRIBUTED INTELLIGENT AGENTS,	
THROUGH 2016 (\$ MILLIONS).....	133
Digital Protective Relays.....	134
TABLE 53 MARKET FOR DIGITAL PROTECTIVE RELAYS, THROUGH	
2016 (\$ MILLIONS).....	134
Intelligent Tap Changers	134
TABLE 54 MARKET FOR INTELLIGENT TAP CHANGERS, THROUGH	
2016 (\$ MILLIONS).....	134
Distributed Energy Management Systems	135
TABLE 55 MARKET FOR DISTRIBUTED ENERGY MANAGEMENT	
SYSTEMS, THROUGH 2016 (\$ MILLIONS).....	135
Grid-Friendly Appliance Controllers	136
TABLE 56 MARKET FOR GRID-FRIENDLY APPLIANCE	
CONTROLLERS, THROUGH 2016 (\$ MILLIONS).....	136
Distributed Power-Flow Controllers.....	136
TABLE 57 MARKET FOR DISTRIBUTED POWER-FLOW	
CONTROLLERS, THROUGH 2016 (\$ MILLIONS).....	137
HIGH-PERFORMANCE COMPUTING	137
TECHNOLOGIES	137
Technologies (Continued).....	138
MARKETS	139
TABLE 58 MARKET FOR SMART GRID–RELATED DISTRIBUTED	
COMPUTING TECHNOLOGIES, THROUGH 2016 (\$ MILLIONS).....	139
CENTRALIZED CONTROL APPLICATIONS.....	139
TECHNOLOGIES	139
TABLE 59 CENTRALIZED APPLICATIONS FOR THE SMART GRID.....	140

<i>TABLE 59 (CONTINUED)</i>	141
PROVIDERS.....	141
<i>TABLE 60 PROVIDERS OF CENTRALIZED SMART GRID CONTROL</i>	
<i>APPLICATIONS</i>	142
MARKETS	142
<i>TABLE 61 MARKET FOR CENTRALIZED SMART GRID CONTROL</i>	
<i>APPLICATIONS, THROUGH 2016 (\$ MILLIONS)</i>	142
INTERFACES AND DECISION-SUPPORT SYSTEMS.....	143
TECHNOLOGIES	143
<i>TABLE 62 INTERFACE AND DECISION-SUPPORT TECHNOLOGIES</i>	
<i>FOR THE SMART GRID</i>	143
PRODUCERS AND DEVELOPERS.....	144
<i>TABLE 63 PROVIDERS OF INTERFACE AND DECISION-SUPPORT</i>	
<i>TECHNOLOGIES FOR SMART GRID APPLICATIONS</i>	144
MARKET	144
<i>TABLE 64 MARKET FOR INTERFACE AND DECISION-SUPPORT</i>	
<i>TECHNOLOGIES FOR SMART GRID APPLICATIONS, THROUGH</i>	
<i>2016 (\$ MILLIONS)</i>	145
APPENDIX A: COMPANY PROFILES	146
INTEGRATED COMMUNICATIONS	146
ALVARION, INC.	146
AMBIENT CORP.	146
AMPERION, INC.	146
ARCADIAN NETWORKS, INC.	147
ARKADOS, INC.	147
CURRENT GROUP, LLC	147
EMBER CORP.....	148
GAINSPAN CORP.....	148
GRIDNET, INC.	149
INTELLON CORP.....	149
INTERNATIONAL BROADBAND ELECTRIC	
COMMUNICATIONS, INC.	150
MAIN.NET POWER LINE COMMUNICATIONS, INC.	150
MMB RESEARCH, INC.....	150
RUGGEDCOM INC.....	151
SMARTSYNCH	151
TELKONET, INC.	152
ZENSYS INC.	152
SMART GRID SENSING AND MEASUREMENT TECHNOLOGIES.....	152
SMART METERS.....	152
Echelon Corp.....	152
Elster LLC	153
eMeter Corp.	153
EnergyICT Inc.	154

Itron, Inc.	154
Landis+Gyr AG.....	154
Sensus Metering Systems	155
Trilliant Networks.....	155
WIRE AREA MEASUREMENT SYSTEMS.....	155
Doubletree Systems, Inc.....	155
Macrodyne, Inc.	156
PowerWorld Corp.....	156
DYNAMIC LINE RATING	156
Electrotech, Inc.	156
Shaw Energy Delivery Services, Inc.	157
The Valley Group, Inc.....	157
USi Power	158
INSULATOR CURRENT LEAKAGE SENSORS	158
PSP Technologies, Inc.	158
Telepathx	158
OTHER SENSORS.....	159
FISO	159
Intelligent Controls, Inc.	159
ADVANCED COMPONENTS	160
POWER ELECTRONICS.....	160
Satcon Technology Corporation	160
Xantrex Technology Inc.....	160
FAULT CURRENT LIMITERS	160
Nexans.....	160
SuperPower Inc.....	161
Zenergy Power plc.....	161
TRANSMISSION CABLE.....	162
American Superconductor Corp.....	162
Composite Technology Corp.....	162
Comverge, Inc.	163
EnerNOC, Inc.	163
Hyper Tech Research, Inc.	164
Metal Oxide Technologies Inc.	164
3M Company	165
Southwire Co.....	165
DISTRIBUTED GENERATION.....	166
MICROTURBINES	166
Capstone Turbine Corp.	166
PHOTOVOLTAICS	167
BP Solar International Inc.	167
First Solar Inc.	167
HelioVolt Corp.	167
Konarka Technologies, Inc.	168

FUEL CELLS	168
Fuel Cell Energy, Inc.....	168
Materials and Systems Research, Inc.....	169
DISTRIBUTED STORAGE.....	169
Accel Instruments GmbH.....	169
Maxwell Technologies, Inc.	169
NGK Insulators, Ltd.....	170
VRB Power Systems Inc.....	170
SMART GRID CONTROLS.....	171
DISTRIBUTED INTELLIGENT AGENTS.....	171
BPL GLOBAL, LTD.....	171
GridPoint, Inc.	171
CENTRALIZED CONTROL APPLICATIONS	172
Intergraph Corp.....	172
Milsoft Utility Solutions.....	172
Silver Spring Networks	173
INTERFACE AND DECISION SUPPORT	173
Space-Time Insight.....	173
APPENDIX B: PATENT ANALYSIS.....	174
<i>TABLE 65 NUMBER OF U.S. SMART GRID-RELATED PATENTS BY</i>	
<i>TYPE OF TECHNOLOGY.....</i>	<i>174</i>
<i>FIGURE 12 U.S. SMART GRID-RELATED PATENTS BY TYPE OF</i>	
<i>TECHNOLOGY, AS OF FEBRUARY 1, 2011 (%)</i>	<i>175</i>