Executive Summary and Findings

As global markets develop and the world's middle class grows at an unprecedented rate, opportunities to drive economic growth in the United States through expanded export sales abroad are also on the rise. With approximately 1.7 billion additional people expected to be connected to electric grids around the world by 2030, the opportunities for suppliers of electricity infrastructure and services are expected to be particularly robust. Under the Renewable Energy and Energy Efficiency Export Initiative (RE4I), the U.S. Department of Commerce's International Trade Administration (ITA) committed to develop tools that will help U.S. companies make strategic decisions and prioritize resources in their efforts to capture export gains in growing energy markets. This report delivers on this commitment for the smart grid sector: it is meant to inform U.S. smart grid suppliers and service providers of key trends, areas of opportunity, and important challenges impacting the development of international smart grid markets through 2015.

Beginning in 2009, the United States has made an unprecedented investment in the modernization of its electricity grid and has since become a world leader in the development and deployment of smart grid technology. U.S. companies large and small provide innovative technology solutions to some of the most pressing challenges facing the electricity industry, and investments by utilities and governments around the world are now driving consistent growth in smart grid exports. Supporting export growth and addressing trade barriers for the U.S. smart grid industry has been a priority for the ITA since the beginning of the President's National Export Initiative. Among ITA's major contributions to this effort has been the delivery of research and analysis and valuable market intelligence to the U.S. smart grid industry.

ITA's 2015 *Smart Grid Top Markets Report* ranks 30 international markets in terms of U.S. smart grid industry export growth potential through 2015 and provides market intelligence that will help inform U.S. companies of opportunities and challenges in international smart grid markets. The report integrates data and analysis on global markets and trade, including the critical contributions of commercial specialists from U.S. Foreign Commercial Service posts. The results are combined using a weighted scorecard methodology to produce relative rankings of the 30 subject markets.

Each subset of the smart grid sector faces different competitive challenges – and each market possesses a set of characteristics that require nuanced and tailored export promotion and policy approaches. This study is not prescriptive of actions for individual companies looking to sell products and services abroad. Instead, the methodology and rankings are meant to provide a platform for analysis that can be useful to a wide range of suppliers and service providers in the U.S. smart grid industry.

The rankings highlight common strengths and weaknesses of the various smart grid export markets. The sub-sector rankings of Smart Grid information and communication technology (ICT) and Transmission & Distribution equipment (T&D) are the result of re-weighting the Smart Grid Top Markets scorecard system to focus on differentiated opportunities for exporters of equipment and services across the smart grid technologies continuum, which is described in detail in the Report.

The following tables summarize the overall rankings and some of the common market characteristics among high, mid, and low ranking markets:

Figure 1: Projected Top Markets for Smart Grid Exports (through 2015)

1. Canada
2. Japan
3. Saudi Arabia
4. Australia
5. United Kingdom
6. Singapore
7. China
8. Chile
9. Philippines
10. Vietnam
11. Mexico
12. Turkey
13. France
14. Malaysia
15. Netherlands
16. Germany
17. South Korea
18. Austria
19. Brazil
20. Colombia
21. India
22. Nigeria
23. Denmark
24. Sweden
25. Indonesia
26. Thailand
27. Portugal
28. Poland
29. South Africa
30. Italy

Figure 2: Understanding Different Types of Smart Grid Markets

	Export Market Clusters	Common Characteristics	Examples *(Rank)*
Top Markets	Major Trade Partners	• Top U.S. Export Market • Geographic and/or Cultural Proximity • History of Success for U.S. Suppliers	Canada *(1)* UK *(5)* Mexico *(11)*
	Smart Grid Procurers	• Growing Smart Grid investment • Major procurements and deployments underway • Advanced Metering Infrastructure a near-term focus	Japan *(2)* China *(7)* France *(13)*
	Healthy Economies	• Stable, healthy, mid to large size economies • Favorable business environments • Investment in electricity infrastructure a priority	Australia *(4)* Singapore *(6)* Chile *(8)*
	Towards Deployment	• Surging electricity demand • Major investment growth in electricity sector • Procurements beginning and favorable competiveness for U.S. firms	Saudi Arabia *(3)* Philippines *(9)* Turkey *(12)* Malaysia *(14)*
Mid-Table	Growth Competitors	• Large markets with growing smart grid investment • Highly competitive local suppliers	Germany *(16)* Korea *(17)*
	Mature Competitors	• Smaller, high-income markets • Have already invested in smart grid infrastructure • More opportunities for smart grid ICT/Services • Less favorable to U.S. suppliers	Netherlands *(15)* Austria *(18)* Denmark *(23)* Sweden *(24)*
	Emerging Smart Grid Markets	• Low income, high growth, including in electricity demand • Major infrastructure challenges • More opportunities for T&D equipment/services • High potential for medium to long-term export growth	Vietnam *(10)* Brazil *(19)* Colombia *(20)* India *(21)* Nigeria *(22)*
Longer Term	Developing Grid Modernization	• Middle-income markets • Current focus on grid modernization • Addressing major issues in wider electricity sector • High potential for longer-term export growth	Indonesia *(25)* Thailand *(26)* South Africa (29)
	Slowing Economies	• Mid-size to large economies • Smart grid investment growth but major risks • Established incumbent suppliers • Poor economic health and/or business environment	Portugal *(27)* Poland *(28)* Italy *(30)*

In addition to the rankings and quantitative analysis, the report examines wider trends impacting the development of smart grid technologies; investment, policy, and regulatory factors driving market development; and the competitiveness of U.S. exporters across the spectrum of smart grid technologies. The report also includes in-depth case studies spotlighting smart grid developments and opportunities for U.S. exporters in 7 featured markets.

Defining the Smart Grid

The smart grid is a modernized, electricity transmission and distribution network that includes two-way communication systems and enables the integration of technologies that will further improve grid efficiency, reliability and security. Depending on the market, a wide range of equipment and technologies will be required to modernize the grid.

Modernization includes the build-out and upgrade of T&D networks that extend electricity services to new populations and also improve on the grid's efficiency in delivering those services. In many markets, modernization goes beyond these initial T&D investments, to include a range of digital technologies and platforms, including the deployment and integration of Internet Protocol (IP)-based communications infrastructure, information technology (IT) systems to better manage increasingly-complex utility networks and data, and online applications and consumer services that enable energy efficiency programs at the "user-end" of the grid.

This report considers a wide range of utility investments in T&D, communications, data networking, IT infrastructure, and energy efficiency services to be part of the worldwide smart grid opportunity for U.S. exporters. The analysis and rankings that follow consider the growth potential over the next year for U.S. exporters of the products and services detailed in Figure 3.

Additionally, U.S. exporters of related energy technologies, including microgrid systems, energy storage technologies, and a wide range of electric utility services, may find the Smart Grid Top Markets Report to be an effective guide to international market growth and potential export gains.

The available data for market sizing and measuring trade flows varies across the spectrum of technologies detailed in Figure 3. The emergent smart grid sector includes evolving networking and information technologies that are driving the convergence between communication and electricity networks. Defining the market and identifying data points that capture and distinguish smart grid investment are significant challenges to market analysis, particularly in emerging and less developed international markets.

The challenge is acute when it comes to smart grid trade data. The existing Harmonized Tariff System (HTS) includes product codes for the "Transmission & Distribution Equipment" listed in Figure 3. But for the most part, HTS product codes for the wide range of hardware, software, and networking technology are non-existent or are too broad to discern *smart grid* applications for these technologies – as opposed to *broadband Internet* applications, for example. Furthermore, data on international trade in smart grid services, like consulting, IT system integration, and consumer energy efficiency programs, is not collected by government or international institutions.

In order to quantify the global smart grid opportunity, this Top Markets Report utilizes the available U.S. Census trade data for T&D equipment, along with smart grid market and investment data – both public and proprietary – to develop a system for comparative

Figure 3: Smart Grid Technology Continuum

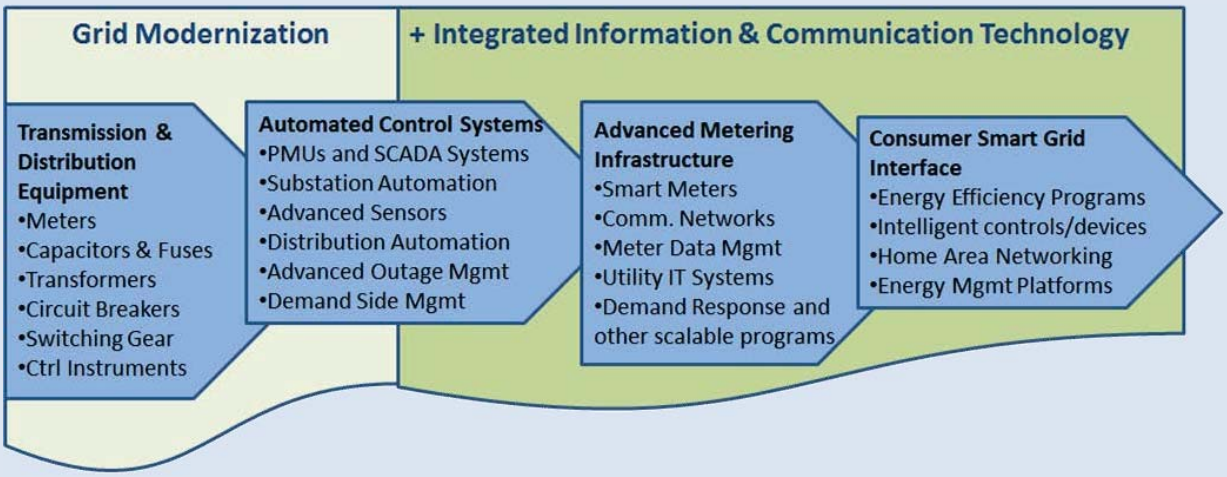
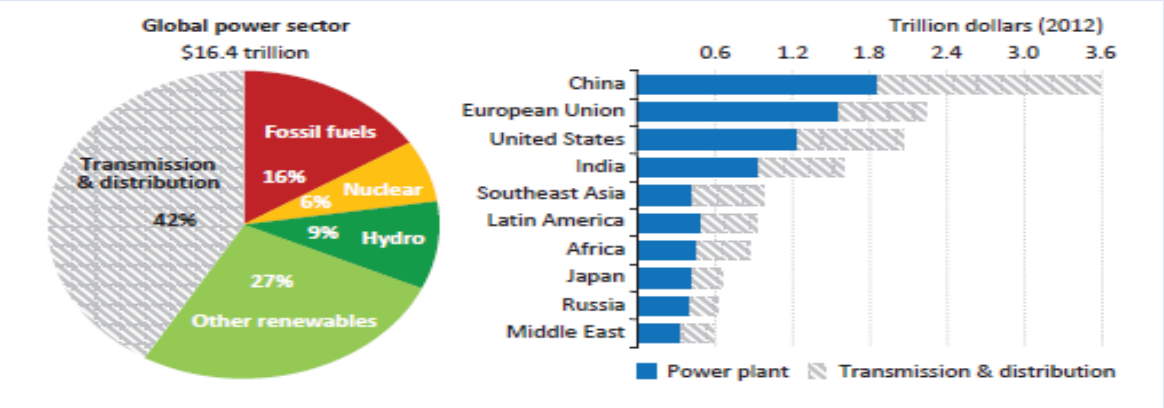


Figure 4: Cumulative Global Power Sector Investment New Policies Scenario, 2014-2035



Source: International Energy Agency, World Energy Investment Outlook 2014.

market sizing and quantifying opportunities for exporters of smart grid ICT and services. Further detail is provided in the *Top Markets Methodology* section of the study.

Smart Grid Market Drivers and U.S. Export Competitiveness

Around the world, governments, businesses, and citizens are beginning to understand that aging electric grids are not equipped to be the critical infrastructure of our energy future and are actively investing in smarter grids. Electricity demand, opportunities to realize efficiency gains, and the potential to lower carbon emissions are among the key factors driving massive global investment in the modernization of electric infrastructure and the development and deployment of smart grid technologies.

According to the International Energy Agency (IEA), world electricity demand is predicted to grow at a 2.2% Compound Annual Growth Rate (CAGR) from 2012 to 2035, and a total of 62 million kilometers of T&D lines will need to be added, refurbished, or replaced in order to meet the growing demand.[1] In the IEA's baseline scenario, the global power sector will require approximately $16.4 trillion in investment over the next 30 years, with T&D infrastructure representing the largest sub-sector share *[See Figure 4].*

Investing in the Grid to Meet National Policy Objectives
In addition to technology innovations, there are a number of policy objectives driving investment in grid modernization. Such investments have the potential to generate societal benefits satisfying three broad "policy driver" categories and supporting a range of policy objectives.

Global spending on grid modernization and smart grid technologies has emerged as a major growth segment in the infrastructure sector, achieving healthy growth even through the recession. According to Bloomberg New Energy Finance, an energy research arm of Bloomberg Media, worldwide annual smart grid spending growth peaked in 2011 at approximately 20%; suffered a loss in 2013, returned to growth at over 10% in 2014, and is predicted to exceed 12% in 2015.[2] Another energy markets research group, GTM Research, predicts that annual spending on the combined smart grid infrastructure, services, and applications markets will grow from $36 billion in 2013 to $63 billion in 2020.[3]

Smart Grid Investment in the United States
In the United States, efforts to upgrade the electric grid in order to meet America's energy, environmental, and security needs for the 21st century have accelerated both public and private sector investments in grid modernization and smart grid technologies. The Energy Independence and Security Act of 2007 (EISA) made it "the policy of the United States to support the modernization" of the electrical grid. Federal and state government and private sector stakeholders have since made major investments in the development and deployment of smart grid technologies and programs that are making the electric grid more efficient, reliable, and secure.

The American Recovery and Reinvestment Act of 2009 (ARRA) provided by far the most significant subsidy

Figure 5: U.S. T&D Equipment Exports and Global Market Share

Source: U.S. Census Trade Data via the Trade Policy Information System of the U.S. Department of Commerce: International Trade Administration

and stimulus to smart grid spending over the last 5 years, making the United States the largest smart grid market in the world from 2009 to 2012. The ARRA smart grid investments included $4.5 billion in government funding for electricity delivery and energy reliability activities to modernize the electric grid and an additional $5.5 billion in matching and additional funds from private sector stakeholders. As of December 31, 2014, approximately $7.5 billion was invested in smart grid deployments and related utility projects as a result of the ARRA programs.[4]

Development of a Smart Grid Export Base to Meet Growing Global Opportunities

As smart grid deployments have advanced in the United States, the domestic industry has developed steadily and a wide range of U.S. technology and service companies lead the global market for smart grid solutions. The available trade data on the T&D sub-sector shows U.S. export growth in total revenues and, beginning in 2009, the reversal of a decade-long trend of falling market share *[see figure 4]*.

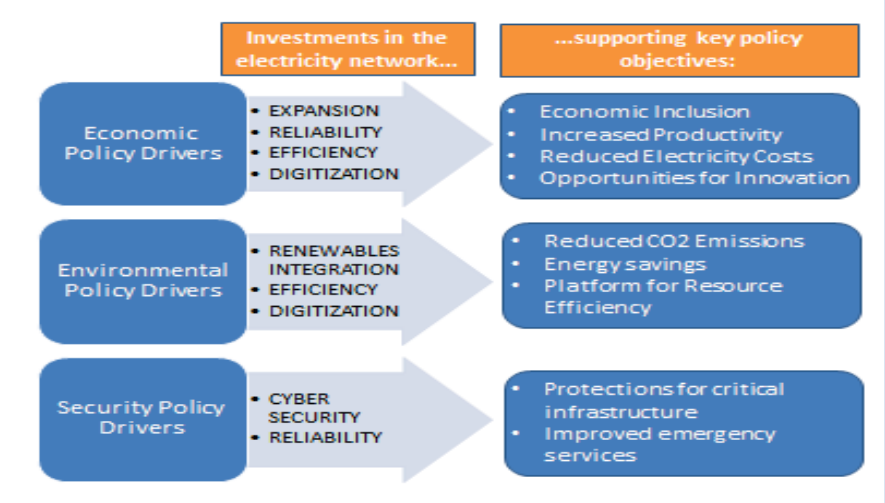
The United States is the third-largest exporter of T&D equipment, behind Germany and China.[5] While limited HTS trade data cannot accurately capture global competitiveness in the smart grid ICT sub-sector, U.S. IT, networking technology, software, and technology service firms are widely viewed as industry leaders. The growth of the domestic smart grid over the last 5 years and increased spending in international markets are now combining to provide expanded opportunities for U.S. innovators in international markets. In 2013, China surpassed the United States, becoming the world's largest market for smart grid spending.[6]

With international investment growth and high U.S. competitiveness, the smart grid sector holds great potential for continued and expanded export growth. In a September 2010 report to the President, the Export Promotion Cabinet identified smart grid as an important sector of the economy with high export growth potential and the industry has been an important component of the National Export Initiative.

Major Issues Impacting Smart Grid Development and Deployment

Investment in the smart grid continues to grow in every major economy and increased export opportunities are anticipated for the wide range of U.S. suppliers and service providers marketing smart grid solutions to electric utilities around the world. However, the development of the smart grid will be unique across – and often within – export markets, and opportunities will vary depending on a nation's stage of smart grid development and specific market demands for various technology and services. Additionally, there are a number of key issues that could impact smart grid development, challenge the

Figure 6 Investments in Electricity Networks Support Policy Objectives



pace of deployment, or hinder U.S. competitiveness in a given export market.

The Top Markets Report considers common policy, regulatory, business, and technical challenges to smart grid development and provides an analysis of their impact on specific markets. These challenges include:

- **Developing Standards and Achieving Interoperability:** the identification and adoption of international standards for smart grid technologies and the need to ensure their interoperability in order to help drive technology development, deployment, and operations.
- **Getting the Regulatory Model Right:** the need for energy sector reforms and the development of a regulatory framework that will sustain smart grid investment and enable sufficient economic returns for the electricity industry.
- **Driving Innovation in the Electricity Industry:** the need for sustainable business models and a coordinated industry approach that ensures investment in new technologies that help achieve the benefits of the smart grid.
- **Enabling the Consumer:** the need for successful consumer protections and engagement in order to help drive demand for smart grid technologies and ensure value for the consumer.

Evolving technologies and policies are driving investment in the smart grid that could translate into export returns for the United States. The rest of this report will examine country-level trends and present an analysis of the top prospective markets for U.S. T&D equipment and smart grid ICT export growth through 2015.

Top Markets Methodology

The Smart Grid Top Markets Report seeks to estimate the potential for growth of U.S. smart grid exports in global markets. This requires the integration and analysis of four broad sets of data and information:

- **Smart Grid Market Growth Potential:** industry data and information on policies, regulations, and other local drivers of the smart grid technologies and services market.
- **Trade Factors and U.S. Competitiveness:** Trade data and other information on exports of U.S. smart grid products and services in a given market.
- **Key Economic and Energy Sector Investment Indicators:** broader economic data and power sector trends that impact investment in electricity infrastructure and the development and growth of the smart grid in a given market.
- **Strength of Domestic Industry:** Trade data and other information on the extent to which demand for smart grid technology and services will be met by the domestic industry – as opposed to international trade – in a given market.

There are a variety of challenges to obtaining comprehensive and quantifiable information for each of these data sets. The smart grid is an emerging technology sub-sector that experts struggle to define, and in an era of technological convergence, many smart grid technologies are multi-use and purchased

outside of the electric utility sector. These are just a few of the factors that challenge smart grid market sizing across nations. And as was previously discussed in this report, existing global trade data only captures accurate and relevant export revenues for a sub-set of T&D goods.

In order to overcome these data challenges, the Smart Grid Top Markets Report integrates data and information on global markets and trade, and provides an analysis that quantifies smart grid markets and export growth potential with a weighted scorecard system. A detailed explanation of the methodology and key supporting data sets can be found in Appendix 1.

A Closer Look at the Top Markets Rankings

As covered in detail in Appendix 1, the Top Markets methodology integrates market data on smart grid investment and deployment data, U.S. T&D exports, policy and regulatory trends impacting market development, and a variety of factors impacting U.S. smart grid industry competitiveness in a given country. The weighted scorecard methodology provides a platform for analysis of different technology sub-sectors depending on the weights assigned to the above factors. Thus, in addition to the overall rankings, the Top Markets analysis also ranks markets for the potential growth of U.S. exports in the T&D Equipment and the Smart Grid ICT sub-sectors. Essentially, these sub-sectors are representative of technologies from the left side and the right side, respectively, of the Smart Grid Technology Continuum [*see Figure 3*].

The following table presents the top half of the Top Markets rankings, including the sub-sector rankings for T&D Equipment and Smart Grid ICT market.

T&D Equipment Sub-Sector
The T&D Equipment sub-sector rankings focus on markets with high growth in the products and services necessary for the build-out, modernization, and automation of T&D networks. For example, trade in T&D equipment receives a higher weight in this ranking, as does electricity demand growth, energy supply investment, and other factors driving the build-out of the grid.

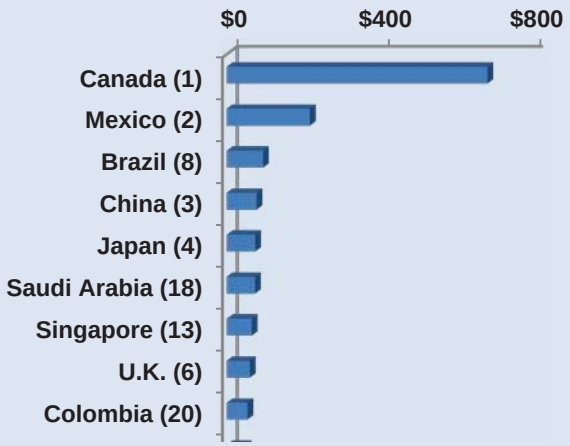
The top T&D Equipment markets are therefore likely to be less-mature smart grid markets: investments in these nations are more focused on grid modernization that is foundational to more advanced Smart Grid ICT development that is still to come. Countries that have been long-standing markets for U.S. suppliers to the electric grid rank higher in this sub-sector, this includes western hemisphere and Middle Eastern markets in particular. Additionally, many Asian markets, where connecting new populations to the electric grid is a priority, will perform well in the T&D sub-sector.

Figure 7: Top Markets Sub-Sector Rankings

	Overall	T&D Equipment	Smart Grid ICT
1	Canada	Saudi Arabia	Canada
2	Japan	Canada	United Kingdom
3	Saudi Arabia	Colombia	Japan
4	Australia	China	France
5	United Kingdom	Singapore	Australia
6	Singapore	Chile	Saudi Arabia
7	China	Vietnam	Philippines
8	Chile	Nigeria	Netherlands
9	Philippines	Malaysia	Denmark
10	Vietnam	Japan	Turkey
11	Mexico	Indonesia	Mexico
12	Turkey	Mexico	Germany
13	France	Turkey	Austria
14	Malaysia	Australia	Singapore
15	Netherlands	Philippines	Chile
16	Germany	Brazil	Sweden

Overall, U.S. T&D equipment exports have performed well in recent years and moderate growth is expected to continue. Total export revenues for the T&D equipment sector reached nearly $2.3 billion in 2013, for 1.2% year-on-year growth and a 12% CAGR over the previous decade. Exports to Canada and Mexico accounted for 39% of this total, and the top ten markets makeup nearly two-thirds.[7] As Figure 7 illustrates, top U.S. T&D export markets do not completely align with those of all goods: relative to other industries, U.S. T&D equipment manufacturers have captured significant returns in nations like Brazil, Saudi Arabia, Singapore, and Colombia.

Figure 8: Top markets for T&D Exports (Rank for U.S. Exports of All Goods) (2013 Revenues, in millions)



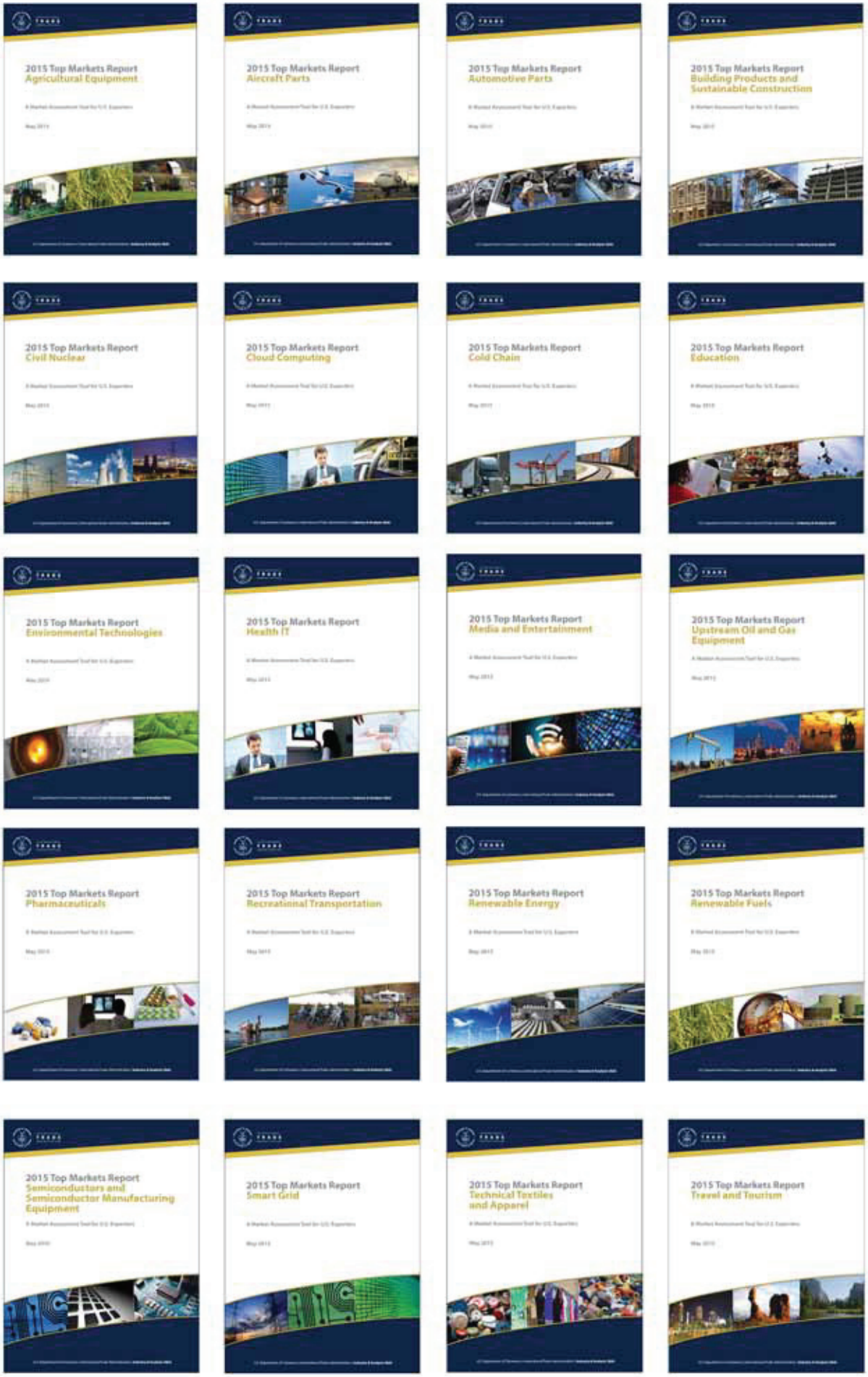
Smart Grid ICT Sub-Sector

Nations deploying Advanced Metering Infrastructure and developing smart grid networks that are beginning to reach consumers are the focus of the Smart Grid ICT sub-sector rankings. For example, Australia and Canada have been widely recognized as first-movers on the deployment of smart meters and advanced metering infrastructure; China is now the world's leading smart meter market; and Japan, the United Kingdom, and other markets in Northern and Western Europe and the Asia Pacific region are catching up fast. Less-mature smart grid markets like Saudi Arabia, The Philippines, Turkey, and Mexico also rank well on account of high U.S. competitiveness and positive signs in the development of smart grid ICT pilots involving U.S. partners.

Case Study Analysis

Drawing from the data and information utilized in the Top Markets analysis, the case studies that follow provide in-depth analysis of the issues impacting seven featured smart grid markets, including the drivers of and challenges to smart grid deployment and the unique opportunities for U.S. exporters.

The Case Studies are meant to provide added market intelligence on markets with unique industry and/or regulatory dynamics and are therefore not confined to the highest ranking markets.



This case study is part of a larger Top Markets Report.
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