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# 2015 Top Markets Report **Renewable Energy**

A Market Assessment Tool for U.S. Exporters

July 2015



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## Executive Summary and Key Findings

The renewable energy industry remains one of the most dynamic, fast-changing, and transformative sectors of the global economy. Technology improvements, cost declines, and the catalytic influence of new financing structures, have turned the sector into a driver of economic growth – both in the United States and around the world. In fact, because policy uncertainty in the U.S. domestic market has restricted growth at home, export markets offer many companies the important opportunity for sales abroad. This *Top Markets Report* provides the commentary on key trends, areas of opportunity, and important challenges that exporters need to compete effectively in foreign markets. It offers both near-term and medium-term projections, as well as eight country case studies with more in-depth information.

The next two years will very likely be as transformative as any two-year period in the history of the clean energy sector. Falling fossil fuel prices, an abundance of natural gas in the United States, and the decreasing cost of renewable energy equipment will combine to make the sector's future far different than what was predicted just a few years ago.

The sector faces many competing dynamics at once – the outcome of which will alter the policy landscape, and thus the investment landscape, for years to come. First, there is a growing global consensus that the world must deal with the threat of climate change in part through the deployment of clean energy technologies. As the world negotiates a climate agreement, almost no country is waiting, choosing instead to promote clean energy development through policy incentives, which should drive investment in almost all markets.

In 2015, this widespread desire to deploy clean energy, however, will begin to run counter to most countries' ability to cheaply import fossil fuels. As fossil fuel prices

remain low globally, countries around the world must decide whether to pursue a clean, sustainable growth path or whether to continue (or even increase) investments in traditional energy sources thanks to lower input costs. The choices they make will govern the industry through both the short and medium-term.

This report provides useful context in which to view export opportunities in a changing world, offering commentary on how exporters can best leverage the trade policy and export promotion tools offered by the U.S. Government. The report is meant to provide context to global markets, helping exporters compare international opportunities across borders. Companies should note that ITA's rankings are based on our current understanding of the market, which – given the pace of change in the sector globally – is subject to change quickly.

For the first time, the *Top Markets Report* includes both near-term (2015-2016) and mid-term (2015-2020) rankings. Like last year's *Top Markets Report*, the study

**Figure 1: Projected Top Markets for Renewable Energy Exports (2015-2016)**

1	Canada	7	India	13	South Africa	19	Thailand	25	Russia
2	Japan	8	Chile	14	Egypt	20	Honduras	26	South Korea
3	China	9	Indonesia	15	Uruguay	21	Denmark	27	Spain
4	Brazil	10	Saudi Arabia	16	Ecuador	22	Philippines	28	Sudan
5	Mexico	11	Germany	17	New Zealand	23	United Kingdom	29	Peru
6	Kenya	12	Turkey	18	France	24	El Salvador	30	Belgium

**Figure 2: Projected Top Markets for Renewable Energy Exports (2015-2020)**

1	Canada	7	Thailand	13	South Africa	19	New Zealand	25	Italy
2	China	8	Chile	14	Indonesia	20	Uruguay	26	Panama
3	Japan	9	India	15	Egypt	21	Turkey	27	Belgium
4	Saudi Arabia	10	United Kingdom	16	South Korea	22	France	28	Sudan
5	Brazil	11	Kenya	17	Honduras	23	Philippines	29	Argentina
6	Mexico	12	Germany	18	Russia	24	Spain	30	Peru

includes rankings of 75 different markets (see Appendix 1), as well as subsector-specific projections. It does not include an analysis of renewable fuels or wood pellets, however, which will be covered in a separate Top Markets Report.

### The Nature of U.S. Renewable Energy Exports

Global renewable energy investment totaled more than \$310 billion in 2014. \* Because most renewable energy technologies cost less in 2014 than in any previous year, the world's investment supported an unprecedented deployment of new renewable energy projects.

But growth is just beginning. According to ITA's projections, markets outside the United States will install 188 GW of new renewable energy capacity through 2016 – and a staggering 657 GW of new capacity through 2020. To meet this demand, the global import market outside the United States is expected to reach \$374 billion cumulatively between 2015 and 2016 – and \$1.4 trillion through 2020.

China is expected to account for more than one-third (35 percent) of all non-U.S. capacity installations over the next two years. Its renewable energy investment is expected to be split relatively evenly between solar, wind, and hydropower through 2016 [for more information on China, see country case study]. Other key developers of new capacity outside the United States will be Japan, India, Brazil, and the European Union (particularly, Germany and the United Kingdom).

What is more, the sector's growth is now global in nature, escaping the traditional markets of Western Europe and strongly taking root in Asia, Latin America, and Africa. Over the remainder of the decade, this trend should continue with important consequences for U.S. export competitiveness.

Unfortunately, U.S. exporters are largely ill-positioned to benefit from rising demand globally. According to ITA's projections, exporters will capture just 3.2 percent of the global import market through 2016. † In Japan, for

example, where imports are expected to account for 75 percent of all products deployed in the market, U.S. exporters are expected to capture just 2.3 percent. In China, U.S. market share will likely be even worse – just 1.5 percent.

The United States does – and should continue to – capture a larger share of the import market in the Western Hemisphere. In fact, the share of the import market captured by U.S. exporters more than doubles in the Hemisphere, reaching 7.8 percent.

While opportunities can be found in most markets, the destination of U.S. renewable energy exports will continue to be highly concentrated. The top 4 export markets are expected to account for over 50 percent of all exports in the sector through 2016, while the top 12 markets should support three-quarters of all exports.

#### Understanding Renewable Energy Markets Globally

The most commented on and lasting impact of the 2014 edition of the *Top Markets Report* was ITA's proposed framework for considering renewable energy export opportunities based on market size and market share. ITA continues to encourage exporters to develop market entry and market expansion strategies based on these two variables [see Figure 3]. Like last year, markets in the report are therefore referenced in terms of their import market size and the share of their import market expected to be captured by U.S. exporters.

If a market is large and U.S. exporters are likely to capture a significant market share, efforts should focus on making as many connections as possible. Exporters can feel good about their prospects, but may find other American competitors also having success in the market. Participation in trade missions, reverse trade missions, trade shows, and other “traditional” export promotion activities is encouraged in these markets. T

Canada is a prime example. Though it is expected to import about one-third as much as China over the next two years from the world, it ranks #1 on ITA's list of projected export markets through 2016, because of the significant market share enjoyed by U.S. suppliers (14.3 percent).

In markets that are large, but in which the United States captures only a tiny fraction of the import market,

imports, 8.0 percent of wind imports, and just 1.0 percent of hydropower imports.

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\* This estimate includes both renewable energy power generation technologies and “energy smart” technologies, as defined by Bloomberg New Energy Finance.

† The United States is the most competitive in geothermal exports (38 percent market share), but that market will be far smaller than other renewable energy markets globally. The United States is expected to capture 5.2 percent of solar

exporters should consider the cause of the United States' insufficient competitive position before pursuing export opportunities, particularly opportunities that include long lead times or require considerable resources. Perhaps importers are demanding products that are not often sold competitively by U.S. exporters, in which case a niche product might play well in the market. However, in certain markets, where U.S. market share is low because of a specific trade barrier, then exporters may want to prioritize other markets and alert U.S. Government entities, so that appropriate action can be taken to remove that barrier.

In markets that are small, but where U.S. exporters capture a large market share, exporters may find significant demand for their products and services, but often a small market or restrictive investment climate that stifles growth. Would-be exporters are encouraged to help the U.S. Government pursue market development activities in these locations, including through trade policy missions, technical capacity building, feasibility studies, and tendering assistance.

Many Latin American markets fall into this category. In these countries, the share of the import market captured by U.S. technology is greater than the share captured globally – often substantially [see Figure 4]. Regrettably, Western Hemisphere markets are expected to account for just \$66 billion of total imports, about 18 percent of the non-U.S. import market (when Canada is removed, this number falls to just 12 percent).

Finally, some markets are neither large nor support significant U.S. market share. While some companies may find niche opportunities, most exporters would be wise to consider opportunities elsewhere.

#### Challenges Facing U.S. Renewable Energy Exporters

In addition to understanding the competitiveness landscape facing exporters in different markets, exporters should also appreciate the other market dynamics facing the sector. For example, the impact of low fossil fuel prices will cascade across the renewable energy sector – both in the United States and around the world. Put simply, reaching “grid parity” – long the dream of the clean energy industry – will be harder to achieve given lower coal and natural gas prices. And in markets that use imported oil to power diesel generators, distributed renewables may seem less attractive.

However, unlike the period around 2009, when low energy prices undermined global renewable energy

investment, the fall in clean energy costs over the past few years should help the industry remain competitive. In fact, in some markets, renewable energy is already cost competitive in markets where policy-makers have implemented effective policies.

A more troubling challenge is likely to come from the slippage of policy support in some key markets. Feed-in-tariffs have been reduced in Europe and Japan, renewable energy targets were scaled back in Australia, while curtailment of renewable generation by utilities has become increasingly common. As a result, the non-U.S. renewable energy market continues to shift heavily towards Asia and other emerging markets, where demand is strong. In fact, none of the top 10 destinations for U.S. renewable energy exporters is expected to be in Europe – a first for the *Top Markets Report*.

Exporters will thus continue to see markets driven more by rising energy demand and a desire to promote economic growth, rather than concerns over climate change (which had traditionally driven European investment in clean energy). U.S.-based suppliers can expect to encounter markets that are more inclined towards protectionism. Policies like local content requirements and import tariffs will likely continue to limit demand for U.S. goods in India, South Africa, Brazil, and Saudi Arabia.

#### Renewable Energy Markets in the Medium-Term

By the end of the decade, U.S. exporters are expected to compete in a global renewable energy market that is larger, even more dynamic, and more far-reaching. Over the next five years, the non-U.S. market is expected to more than double, with growth expected in every subsector – although most exports will remain destined for a small group of countries.

U.S. exports will very likely be the most competitive in the geothermal market, but geothermal development will remain well behind other renewable energy sectors. Hydropower is expected to install more renewable energy capacity than any other technology (nearly 300 GW), although development of wind and solar capacity should be substantial – and more widespread – as most large hydro projects will be in just a few countries. In total, China should account for the vast majority of new capacity installed outside the United States (40 percent of non-U.S. capacity installations are projected in China through 2020).

Over the medium-term, most international renewable energy development will occur in Asia, but most exports will be destined for markets closer to home. U.S. exporters will compete effectively in many Western Hemisphere markets, but will wish these markets rivaled others in terms of overall investment. While in large markets, U.S. exporters will often be relegated to fringe opportunities, as domestic supply chains or lower-cost suppliers win additional market share.

Optimizing U.S. Government Leverage

ITA continues to encourage exporters to understand how the unique missions of different U.S. Government agencies can offer support in foreign markets. Perhaps the most impactful way to leverage U.S. Government support is the use of financing tools for both export promotion and capacity building.

In some markets, for example, exporters can be disadvantaged by distance from their customers or the availability of cheaper products sourced from elsewhere. The U.S. Export-Import Bank (ExIm) can provide a comparative advantage by delivering financing rates attractive to developers, which requires them to use technology imported from the United States. In addition, exporters should consider working with the U.S. Trade and Development Agency (USTDA), which can provide feasibility studies for projects in emerging markets, or the U.S. Agency for International Development (USAID), which can provide a key first-mover advantage in many developing countries.

**Methodology**

ITA is proud that its methodology has again improved in this edition of the *Top Markets Report*. While assessing renewable energy trade remains difficult and inexact, the 2015 methodology incorporates both improved data and more detailed sector-specific information. ITA is thus more confident than ever in the accuracy of its rankings. As in previous editions of the study, ITA has sought to be clear about the assumptions made in its analysis and welcomes commentary on ways to improve.

For each market, we estimated the projected capacity installations for each technology through 2020 using projections from *Bloomberg New Energy Finance* and *Business Monitor International*, as well as several sector-specific sources. We then estimated the value associated with each market’s expected capacity growth by multiplying its capacity growth projected by the cost of each technology. For the first time, ITA used country-specific and regional estimates for the cost of technology using levelized cost of energy and CAPEX estimates from *Bloomberg New Energy Finance*.

We then estimated the proportion and value of the market likely to be met by imports, as well as the percentage of imports expected to come from the United States. In doing so, we were able to calculate a projected export market for each country and each subsector within countries, allowing markets to be compared against each other [see Figure 6].

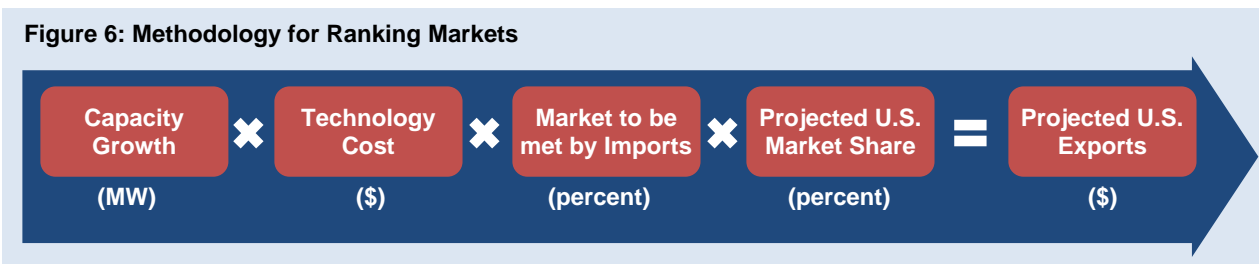
Caveats

The renewable energy sector is so reliant on policy, that any policy changes – either positive or negative—will have an almost immediate impact on a market’s attractiveness. As a result, the rankings provided in this report are subject to change substantially as new policies are announced.

It is important to note that the *Top Markets Report* only includes an analysis of product exports, which are easier to track using harmonized tariff system codes. Service exports, which may provide an even greater opportunity than the export of products, are not included in the rankings.

Based on work undertaken by the U.S. International Trade Commission, ITA believes that service exports are highly correlated with the export of renewable energy equipment. As such, the rankings featured in this analysis should provide policy-makers an adequate assessment of service export opportunities despite their exclusion from the methodology.

Moreover, this analysis does not include an assessment of regional opportunities, although regional estimates





are possible based on the methodology. In some markets like Central America or the European Union, exporters can consider opportunities based on regional energy policies or transmission infrastructure. Thus while individual markets may rank low, opportunities when paired with other regional projects may be considerably larger.

### **Case Studies**

ITA identified eight countries for in-depth case studies: Brazil, Canada, Chile, China, India, Japan, Mexico, and Saudi Arabia. The markets represent a range of countries to illustrate a variety of points – not the top markets overall. The case studies describe each country’s renewable energy market and include specific commentary on the competitive position of U.S. exporters, as well as opportunities for exporters by subsector.

Based on positive feedback from last year’s *Top Markets Report*, we have also provided sector snapshots on the wind, solar, geothermal, and hydropower markets. These snapshots provide sector-specific market trends and project export competitiveness in these sectors in both the near-term and mid-term.

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### **Country Case Studies**

The following pages include country case studies that summarize U.S. renewable energy export opportunities in selected markets. The overviews outline ITA's analysis of the U.S. export potential in each market for each renewable energy subsector. The markets represent a range of countries to illustrate a variety of points– not the top markets overall.

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# Brazil

Type: Large Market; Large Market Share

Brazil is Latin America’s largest renewable energy market. Despite its stagnant economic growth, ITA expects continued investment in wind, solar, and hydropower capacity growth into the future. However, substantial import barriers often make the market complicated and frustrating for American exporters. Exporters are expected to face strong headwinds from local content restrictions, but may find niche opportunities providing technologies not already manufactured locally.

Sector Rankings		Overall Rankings
Geothermal <b>N/A</b>	Hydropower <b>21</b>	Near-Term <b>4</b>
Solar <b>21</b>	Wind <b>3</b>	Mid-Term <b>5</b>

Despite flat economic growth, the reelection of President Rousseff portends a continuation of Brazil’s renewable energy policy environment, which has facilitated near continuous investment in the sector across a broad range of subsectors. While wind and hydropower have been the source of Brazil’s renewable energy expansion to date, ITA expects new solar development to begin in earnest, eventually rivaling new investment in wind power.

Were the Brazilian renewable energy market as open to U.S. exporters as other markets in the region, no country would support more U.S. exports. As it stands, Brazil ranks fourth on ITA’s list of top projected export markets through 2016, falling one spot from last year’s rankings. Most exports are the result of sheer volume; not significant increase in U.S. market share.

In 2014, renewable energy investment was catalyzed by one of the worst droughts in Brazilian history, which reduced power generation at some of its most important hydroelectric facilities and even stoked talk of power rationing and electricity rate hikes.<sup>1</sup> Higher prices would weaken economic growth in Brazil further, as consumer buying power is eroded.

The country’s ongoing drought may even lead to electricity shortages in the near-term, potentially creating a market opportunity for distributed renewable energy providers, particularly roof-mounted solar PV. In the longer-term, the economic realities caused by the drought may shift the Brazilian Government’s support towards renewables even further – a development further supported by low oil prices, which make investments in difficult to access reserves less likely.

## Overview of the Renewable Energy Market

While no specific legislative targets exist to drive demand for renewable energy generation, Brazil’s “Ten Year Energy Plan” published in 2011 called for 18 GW of new capacity to come online by 2020. Under the plan, Brazil will maintain a significant large hydropower industry, which currently accounts for roughly 80 GW of the country’s installed capacity. Other renewable energy sources, however, were set to grow faster on a percentage basis.<sup>2</sup>

In 2009, Brazil began a series of successful reverse auctions to govern and facilitate the deployment of renewable energy technologies. Through the reverse auction system, which has since been duplicated in other markets around the world, developers seeking to build renewable energy projects compete against proposed conventional energy projects in regular tenders. The auctions thus reduce the price paid by Brazilian consumers for renewable energy, as developers are incentivized to offer the lowest possible cost.

The focus on price competition traditionally limited opportunities for solar or other higher priced technologies, but in October 2014, Brazil tendered 889.6 MW of solar capacity through the reverse auction system for the first time. These projects are expected to come online in 2017.<sup>3</sup> As the cost of installing solar energy technologies continues to decline, future auctions will likely see more solar projects submitted.

For technology suppliers, the reverse auction system provides a long pipeline of planned and approved projects. Exporters and export promotion professionals

are encouraged to seek out auction winners to facilitate export sales. Based on previous auctions, ITA expects a total of 7 GW of wind power projects to be commissioned in 2014 and 2015, with 4.7 GW already awarded and due online in 2016 and beyond.

### **Challenges and Barriers to Renewable Energy Exports**

Exporters should compete well in Brazil given its proximity to the United States, but persistent local content requirements have restricted market access and catalyzed investment in local manufacturing. As a result, Brazil remains one of the most frustrating and complicated markets for U.S. renewable energy exporters. Its system of protectionist policies reduce the competitiveness of foreign technology suppliers; and its high import tariffs (14 percent for wind turbines and wind component parts; 12 percent for solar cells and modules) ensure that even if an export deal is obtainable, that U.S. suppliers can often be underbid by local suppliers.

The ability of local suppliers to underbid U.S. exporters is further eroded by the financing terms offered by Brazil's national development bank, Banco Nacional de Desenvolvimento Econômico e Social (BNDES). For most renewable technologies, project developers can technically use non-locally sourced equipment, but the use of foreign equipment makes them ineligible for low-cost BNDES loans. Almost all projects therefore use BNDES financing and are thus subject to the Bank's phased industrialization policy.

BNDES amended its local content requirements for wind projects in 2012, announcing that would require developers that utilize their financing to purchase all wind turbine components from Brazilian manufacturers by 2016. In August 2014, BNDES announced similar plans for the solar industry. For crystalline silicon PV panels, the roadmap includes three phases and ends with all cell produced locally by 2020. For thin-film, the plan has only two phases that end in 2018 with all module assembly and cell definition done in Brazil.

While no solar manufacturer has announced plans to manufacture in Brazil, several have acknowledged an interest in manufacturing locally. According to industry sources, 500 MW of capacity must be contracted annually via Brazil's reverse auction system to justify investments in new manufacturing facilities; 880 MW was announced in the first-ever auction that included solar with larger capacity installations likely in the

future.<sup>4</sup> As such, we expect PV suppliers to manufacture in Brazil soon, limiting export opportunities in the medium-term to component parts and materials, particularly for those manufacturers that have deep supply chains in the United States. In other instances, Brazilian firms may seek to license U.S. technology directly.

Importantly, BNDES published its investment plan for the next four years in December 2014. In it, the Bank acknowledged that there may be cuts to money transfers from the Brazilian Treasury to its budget, potentially making BNDES financing more difficult to secure.<sup>5</sup> Capital markets might therefore need to play a larger role in the Brazilian market, potentially creating an opportunity for U.S. exporters to sell to projects not supported by BNDES and thus without local content restrictions.

### **Opportunities for U.S. Companies**

Through 2020, ITA expects U.S. exports to Brazil to result from sheer market volume, as opposed to distinct U.S. competitiveness. Nevertheless, exporters should be able to find niche opportunities, particularly with the help of U.S. export promotion professionals.

#### Solar

Today, Brazil has almost no solar capacity installed, although growth is anticipated, particularly in the medium-term (post 2016). By 2023, Brazil expects to have 3.5 GW of solar capacity online. According to BNDES's investment plan, it will invest \$2.5 billion in solar development through 2018.

For U.S. exporters, the opportunity is now – and will likely diminish over time. Through 2017, BNDES's local content requirements mandate that solar modules be assembled in Brazil, but cells and other equipment can be imported.<sup>6</sup> While this will change as LCR mandates intensify, U.S. exports should find some opportunities in the short-term. As Brazil does not currently have a completed solar supply chain in-country, imports will be required.<sup>7</sup>

Polysilicon producers, wafer manufacturing, and solar cell providers should all find opportunities. Solar project developers and other service providers may find more lasting opportunities, as the market expands over the remainder of the decade.

### Wind

Wind capacity in Brazil – already the largest in Latin America – should continue to buttress renewable energy growth for the foreseeable future. Brazil enjoys one of the world’s strongest wind resource bases; and with wind energy expected to reach grid parity in the near future, even more investment is all-but-certain. According to the Brazilian Government’s Energy Research Agency, the wind industry will need to install 17 GW of new wind capacity over the next decade to meet the country’s target of 22.4 GW of capacity by 2023.<sup>8</sup>

Based on ITA’s projections, Brazil should account for roughly 15 percent of all wind exports from the United States through 2016, ranking it third on ITA’s list of top export markets over the near-term. Wind service providers should find the most opportunities since LCRs and other import barriers will reduce the competitiveness of component suppliers. Resource mapping, turbine design, environmental impact

assessments, and other consultancy services are likely to be in high demand and should offer opportunities for U.S. companies.

### Hydropower

ITA also expects some export opportunities to result from changes in Brazil’s hydropower market. The lack of production from some of Brazil’s largest hydropower dams, because of ongoing draught, has made the market captive to the expertise of engineering firms that can increase capacity through technological services. U.S. firms should also benefit from increased development of small hydropower plants, where U.S. technology is often highly competitive.

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# Canada

**Type: Large Market; Large Market Share**

Over the next two years, Canada will account for nearly one-fourth of all U.S. exports in the sector. Its proximity to the United States and the close commercial relationship enjoyed by many U.S. suppliers provides exporters a favorable environment to sell their products or services. Thus while the market will remain much smaller than other, more dynamic clean energy markets globally, no market will account for more exports. As such, Canada again ranks #1 on ITA’s list of top renewable energy export markets for the second year in a row.

Sector Rankings		Overall Rankings
Geothermal <b>N/A</b>	Hydropower <b>1</b>	Near-Term <b>1</b>
Solar <b>5</b>	Wind <b>1</b>	Mid-Term <b>1</b>

Canada is the only market to rank in the top five in three different subsectors. Its vast renewable energy potential and its national commitment to greenhouse gas reductions suggest significant clean energy investment through at least 2020. Yet, its hodge-podge of provincial level policies in support of clean energy and the large-scale development of fossil fuel resources suggest that growth will remain regional, with some provinces developing large quantities of clean energy projects and others attracting little overall investment.

Canada has undergone dramatic changes in its energy sector over the past few years, including the development of new renewable energy capacity alongside unconventional fossil fuel development.<sup>9</sup> Although coal and other fossil fuels will likely remain a pillar of Canada’s energy mix for the foreseeable future, clean energy investment is expected to create opportunities for U.S. suppliers in both the near- and medium-term.

Unlike other markets where a lack of competitiveness limits overall exports even with widespread growth, the United States’ competitive position within Canada means that even sporadic growth will support exports. U.S. and Canadian supply chains are so interlinked that any renewable energy project, regardless of the technology used or even the project developer in charge, will often source technology from the United States.

### Overview of the Renewable Energy Market

Canada is expected to install the sixth most renewable energy capacity through 2016 outside the United States – only China, Japan, Germany, India, and Brazil will install more. ITA expects Canada’s new capacity to split relatively evenly between wind and hydropower development, although the hydropower sector should attract more exports.

While national level policies exist, including the Canadian Government’s national target to reduce greenhouse gas emissions by 17 percent below 2005 numbers by 2020, most of Canada’s clean energy policies are created and enforced at the provincial level meaning development will be uneven between provinces. For example, Nova Scotia’s tidal energy program, Ontario’s Feed-in-Tariff (FIT) regime, and Québec’s provincial clean energy mandate have all led to increased investment in the sector.

Ontario and Québec have historically been the most supportive provinces for renewable energy development, although both provinces face difficult choices post-2015. If one or both provinces decide to continue their investment in renewable energy through FITs, Canada will likely continue to be a critical market for U.S. exporters. If both reduce their incentives, Canada may become an episodic market, only occasionally providing opportunities for U.S. firms.

While other provinces maintain incentive programs and enjoy a resource potential that could support

development, without either improved economics or more government incentives, development in these locations should remain limited.

### **Challenges and Barriers to Renewable Energy Exports**

Canada's two largest provinces are also the two with the most challenging policy environment for U.S. exporters to compete. Québec, for example, has the most stringent local content provisions in Canada, requiring that 60 percent of a project's cost, and 30 percent of wind turbine costs (in the case of wind power), are spent in the province.

Canada's use of LCRs can be viewed as an acknowledgment of its inability to develop local innovation and entrepreneurship. Because its provinces want to be leading clean energy producers, LCRs have been used to mandate that firms manufacture locally. As such, some U.S. exporters may find interest in licensing their technology to Canadian firms.

Moreover, exporters may be better positioned in provinces without substantial manufacturing sectors. Alberta for example – Canada's only completely deregulated electricity market – has strong wind resources, and falling clean energy prices may make the sector competitive economically with other forms of energy. It does not mandate the use of local content and could be a good candidate for off-grid renewable energy technologies – namely, solar PV, distributed wind, and co-generation geothermal – particularly, at existing fossil fuel sites.

### **Opportunities for U.S. Companies**

Most export sales in Canada are the result of existing commercial relationships between companies in both countries. Yet, with its growing clean energy market (albeit at a slower rate than elsewhere) and its proximity to the United States, Canada can be a great place for new-to-export firms to make their first sales abroad. Companies interested in becoming exporters should work with their local U.S. Export Assistance Center to determine their export readiness and develop an export plan.

#### Wind

Canada tops ITA's list as the largest wind export markets in the near-term (it falls to second over the medium-term), despite its relatively minor expected capacity growth. Its status as the largest export

destination for U.S. wind energy exports is a result of the highly competitively nature of U.S. suppliers in the market. Nearly one-fourth of all Canadian imports (measured by value) in the sector are expected to be met by U.S. suppliers. Many of these exports will occur with or without export promotion support or even U.S. Government financing.

While no off-shore wind market exists in Canada, the country's geography offers immense possibilities for future development. However, unlike other developed countries, most of Canada's citizens do not live near the coast and thus offshore wind is less attractive. Its attractiveness is further diminished by the presence of low cost hydropower resources that are often far closer to population centers.

#### Hydropower

Canada is the world's largest generator of hydropower and plans to increase its capacity going forward.<sup>10</sup> Nova Scotia, Québec, British Columbia, and Labrador are expected to add the most hydropower capacity, although smaller development can be expected elsewhere.

Given the competitive position of U.S. exporters in the market, this expected development should support considerable U.S. exports over both the near- and medium-term. And while most hydropower turbines will likely be sourced locally or imported from Europe, the services associated with Canada's hydropower investment should provide additional export opportunities, as should the supply of component parts, which enter the market duty free as a result of the North American Free Trade Agreement (NAFTA).

Canada therefore ranks #1 on ITA's list of top hydropower export markets. The market should account for half of all exports in the sector through both 2016 and 2020 – more than any market in any other renewable energy subsector.

Importantly, Canada has made significant strides in tidal and ocean power, with continued development expected in 2015 and beyond. Nova Scotia, which has some of the world's highest and fastest tides, announced in June 2014 that it signed an agreement to construct a tidal power station to be commissioned in 2015 with UK-based Nautricity. The province says it is on track to produce 20 MW of tidal power by 2020 and will have several experimental in-stream units testing by the end of 2015.<sup>11</sup> Estimates

indicate that Nova Scotia alone could provide as much as 30 GW of tidal energy.

#### Solar

ITA expects little solar development in Canada through both the short and medium-term. As a result, Canada fell from the #1 expected solar power export market in last year's report to #5 in this year's *Top Markets* projection. Most solar projects will remain small-scale utility projects or roof-mounted projects in those provinces that provide distributed generation incentives. Despite limited growth, Canada's lack of manufacturing capacity in the sector should support export opportunities for U.S. equipment suppliers.

#### Geothermal

Despite an abundance of geothermal potential, there are no policy incentives for geothermal development in any Canadian province. Canada therefore has not commissioned a single geothermal facility to date. Saskatchewan, however, announced Canada's first planned geothermal project in 2014, with operations beginning in 2015.<sup>12</sup> Five additional projects are also in the early stages of development. ITA expects future growth in the sector to be small, with isolated projects used for small-scale distributed generation or district heating (particularly in Northern Canada) the primary driver of any development.

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# Chile

**Type: Small Market; Large Market Share**

Chile’s resource potential, its traditionally high electricity prices, and the expected market share captured by U.S. suppliers strongly suggests export competitiveness across each renewable energy technology through 2020. Chile is one of the few markets that should support exports in each renewable energy technology and, as such, remains a critical market for many U.S. exporters. Most export opportunities are expected in the solar sector, including both PV and Concentrated Solar Power (CSP).

Sector Rankings		Overall Rankings
Geothermal	Hydropower	Near-Term
6	2	8
Solar	Wind	Mid-Term
4	15	8

Few countries have as much renewable energy potential, and as much need for renewable energy as Chile. The Atacama Desert in Northern Chile is widely considered the world’s best solar resource. Similarly, strong wind, geothermal, and hydropower resources exist across the country.

Partly as a result of this potential and partly because Chile has no domestic energy resources, Chilean policy-makers have made a firm commitment to support clean energy investment. Today, the country is home to a prodigious array of renewable energy projects across each technology subsector – many with the expectation of selling electricity on the spot market (almost unique among clean energy projects globally).

While most development is expected in the solar sector, export opportunities are expected across all clean energy technologies and services. Chile is one of only three markets to rank in the top ten in three different subsectors and the only market to rank in the top 15 in all four.

### Overview of Renewable Energy Market

Chile must rely on imported electricity to fuel its economic growth, which has been consistent and robust for over a decade. Imports have grown dramatically as a result, rising from 42 percent of all energy consumption in 1980 to almost 75 percent today. The country’s import dependence has caused electricity spot market prices to reach an average of \$112.3/MWh on the country’s main electricity grid in

2013 – far more than other regional markets and a distinct competitiveness disadvantage for the Chilean economy.

The high prices have in turn led to an incredibly robust and attractive renewable energy market, supported by both private-sector consumers in Chile – namely, large mining operations – and the Chilean Government. The country is the first where wind and solar projects are being developed and financed on a purely merchant basis.<sup>13</sup> While low oil prices may make imports less problematic for the Chilean economy, ITA believes electricity prices will remain high enough – and volatile enough – to make it likely that Chile will continue to invest in renewable energy going forward.

Chile’s President, Michelle Bachelet, has called for 1.2 GW of non-conventional renewable energy over the next four years. The added capacity will support Chile’s target of producing 20 percent of total electricity generation from renewable energy by 2025 (this is double Chile’s original target). To facilitate this development, Chile has created a new \$6.7 million fund to seed private-sector investment in the sector.<sup>14</sup>

Since taking office, President Bachelet’s administration has approved over 75 different renewable energy projects, with many more likely to be approved in the coming years.<sup>15</sup> With no import restrictions and a preference for cutting-edge technologies, these projects should support a consistent export opportunity for years to come.

Moreover, Chile became the first country in Latin America to impose a carbon tax when in September 2014 its Congress passed the so-called *impuesto verde*. The tax, which will become operational in 2017, is set to impose a \$5 per tonne of CO2 tax on emitters with installed capacity equal to or larger than 50 MW, excluding those that use biomass as a feedstock.<sup>16</sup>

### **Challenges and Barriers to Renewable Energy Exports**

Despite its projected growth, Chile has only deployed 1.9 GW of non-conventional renewable energy technologies to date.<sup>17</sup> This is largely a result of transmission challenges, which remain both persistent and disruptive. The country's electricity infrastructure is entirely privatized. The Chilean Government thus faces hurdles in incentivizing the development of new transmission lines, particularly in remote areas where renewable energy projects are often located.<sup>18</sup>

Chilean utilities, not having experience with large amounts of renewable power, have also shown signs of uneasiness about allowing additional renewable energy onto their electricity grids. Nevertheless, utility operators may have no choice but to support the use of intermittent renewable sources in their power mix, as the Chilean Government has announced that renewable energy will account for more than 75 percent of the nearly 5 GW of new capacity added to Chile main electricity grid through 2030.

Inviting grid operators to study how best to incorporate renewable energy into a reliable grid infrastructure could quell this problem and facilitate additional investment. It could also help facilitate a comfort with U.S. technologies that would no doubt benefit exporters looking to sell into the market.

Chile relies mostly on market conditions to support clean energy development (unlike other markets), because the changes in market dynamics could negatively influence investment in the future. For example, as Chile's ability to purchase fossil fuels on global markets increases, the relative attractiveness of renewable energy may decline. Power demand could also decline – particularly in the short-term – as demand for Chilean minerals decrease as a result of a slowdown in Chinese manufacturing.

Last year's *Top Markets Report* identified the lack of local financing for renewable energy as a major impediment to future growth. In 2014, there were significant signs of local investor interest in the sector,

and thus this concern is removed from our list of potential barriers. Project developers appear to be gaining greater access to both international and local financiers and this should support further capacity installations.

### **Opportunities for U.S. Companies**

U.S. exporters are well-positioned in Chile due to the existing U.S.-Chile Free Trade Agreement and the strong bilateral commercial relationship between the United States and Chile.

#### Solar

Chile ranks fourth on ITA's list of largest projected solar export markets through 2016 – down two spots from last year's ranking. The drop is a result of fewer projects expected to come online, not a loss of market share captured by U.S. firms. Chile's Environmental Assessment Service recently approved 698 MW of new solar projects in September 2014, a number far smaller than other potential solar markets.<sup>19</sup>

While capacity growth may be somewhat limited in the short-term, ITA expects the solar industry to account for over half of all renewable energy exports to Chile through 2016. With no solar manufacturing capacity currently in operation, all of Chile's solar development will be met by imports, creating an important opportunity for U.S. equipment and service providers.

In October, President Bachelet helped break ground on a 141 MW solar project in Atacama Region III, which is being developed by First Solar, the largest U.S. solar company.<sup>20</sup> Once completed, the project will be the largest solar project in Latin America and should drive further interest in the sector, particularly for large mining companies with operations in the Atacama region.

Going forward, it will be important for exporters to keep Chilean decision-makers aware of the latest solar technology developments in the United States. In particular, Chile's mining sector has routinely required solar investments to demonstrate an energy storage component to fuel their 24/7 operations. Demonstrating advances in storage related to concentrated solar power may therefore help create opportunities for firms able to meet these requirements.

### Wind

Chile's wind power development is expected to be limited in both the near and medium-term. Some development should take place, as the country's high priced electricity and tremendous resource potential make projects attractive to developers. For example, the Italian firm Enel Green Power began construction of a 61 MW wind project in September 2014 that is scheduled to begin operation in early 2015.<sup>21</sup>

### Hydropower

ITA expects small- to medium-sized hydropower exporters to find opportunities developing projects in the short-term. In fact, Chile ranks behind only Canada in terms of projected hydropower exports to 2016. Run-of-river hydropower projects in low-flow areas like irrigation and already constructed navigational dams should provide the most export opportunities.

ITA does not expect significant opportunities in the large hydropower sector. In early 2014, the Chilean Government cancelled the environmental permit for

the proposed 2.7 GW HydroAysen project in Patagonia, likely signaling a dampening of support for large hydro development in the future.<sup>22</sup>

### Geothermal

Despite its vast geothermal potential, Chile has commissioned no projects to date. However, a 2012 tender generated \$250 million worth of investment for 20 geothermal energy exploration concessions that should be commissioned beginning in 2015, ranking Chile sixth on ITA list of top geothermal export markets to 2016.

Most of Chile's geothermal development, however, will be brought online between 2016 and 2020.<sup>23</sup> U.S. suppliers are expected to capture a staggering 50 percent of Chile's geothermal import market, making it one of the most U.S.-friendly business destinations of any renewable energy market globally.

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# China

**Type: Large Market; Small Market Share**

China has been the world’s largest wind market for the past five years, became the world’s largest solar market in 2013, and will likely be the largest hydropower market in the near future. China’s unprecedented investment continues to be driven by a growing policy consensus in support of clean energy at the highest levels of the Chinese Government. But, U.S. exporters often struggle to gain market share and, as a result, ITA expects exports to grow based almost exclusively on sheer market size rather than the competitiveness of American suppliers in the market.

Sector Rankings		Overall Rankings
Geothermal	Hydropower	Near-Term
19	19	3
Solar	Wind	Mid-Term
7	2	2

China is both the world’s largest producer and consumer of renewable energy technologies. Over the next two years, it will account for nearly one-third of all renewable energy capacity installed outside the United States – by 2020; the number will be even higher around 40 percent. This tremendous expected capacity growth will make China the largest market for solar, wind, and hydropower technologies in both the short and medium-term.

Coal, the traditional backbone of China’s power mix, has therefore seen its share of China’s installed capacity decrease nearly 20 percent in just four years.<sup>26</sup> Today, renewable energy accounts for the majority of all new capacity additions.<sup>27</sup> According to industry sources, the industry received a staggering \$29.2 billion worth of investment in the first six months of 2014 – a 17 percent increase over the first half of 2013 and over \$161 million per day.<sup>28</sup>

China, however, fell one spot in ITA’s rankings of top export markets since last year, due to the persistent lack of market share captured by U.S. exporters across all subsectors. U.S. exporters are projected to capture less than two percent of the Chinese import market, and far less of the overall market, much of which will be met mostly by domestic suppliers.

As China begins to develop its next Five-Year Plan, ITA expects pricing reforms, further diversification of China’s energy mix, and increased privatization of energy assets, to form the basis of a strong and unparalleled clean energy market through 2020. The Plan will be further supported by China’s commitment in November 2014 to cap its carbon emissions and to obtain 20 percent of its energy from renewable sources by 2030.

### Overview of the Renewable Energy Market

A number of factors will drive renewable energy investment in China; not only is China the world’s most populous country but it also has the largest installed generating capacity. It also has the largest electricity demand, which surged 51 percent in just the last five years, and should continue to grow.<sup>24</sup>

According to industry sources, these commitments – if achieved – would turn the world’s largest renewable energy market into an absolute clean energy behemoth, potentially changing both trade flows and investment destinations for years to come. Assuming China’s energy demand doubles by 2030, as predicted by the International Energy Agency, it will need to install 1,000 GW of new clean energy capacity to meet its commitment to the United States.<sup>29</sup> In other words: China will need install the clean energy equivalent of Spain’s entire generating capacity every year between now and 2030 just to meet its commitment – something it has only achieved once (in 2014).<sup>30</sup> *Bloomberg New Energy Finance* notes that this demand will likely require at least 400 GW of

China also has the highest total CO<sub>2</sub> emissions of any country and persistent environmental challenges, which every year become more and more acute. While China has long supported clean energy development to increase exports, it has increasingly viewed the sector as mutually supportive of its domestic environmental goals. As a result, it supercharged its investment in the sector since the 12<sup>th</sup> Five-Year Plan in 2010.<sup>25</sup>

hydropower capacity, 500 GW of wind, and 300 GW of solar power by 2030.<sup>31</sup>

### **Challenges and Barriers to Renewable Energy Exports**

Anecdotal evidence suggests that few markets are more challenging for U.S. exporters than China. The lack of intellectual property (IP) rights protection and enforcement remains a consistent deterrent for many U.S. technology suppliers. Small- and medium-sized firms are often hesitant to export to China, although it is these firms, with innovative new technologies not yet introduced to the market, which may offer the greatest opportunity for export success.

The structure of China's power sector is another deterrent. State-owned enterprises dominate the market and are highly regulated. The government directly controls wholesale and retail electricity prices and often determines which renewable energy projects go forward and which stay on the drawing board. U.S. developers often complain that projects developed by local companies move faster and garner more support from Chinese authorities.

Moreover, Chinese industry has entered a period of intense restructuring. ITA expects this trend to continue through 2016, as demand for products reaches the availability of supply. Many Chinese solar manufacturers, for example, carry large amounts of debt and have exhibited poor capital control, making volatility in the sector all the more likely. Larger players may well be able to purchase the assets of debt-ridden firms at discount prices if the market continues on its current path. This could leave a few, very powerful Chinese manufacturers able to dominate the Chinese market, while also competing effectively in third-country markets around the world.

### **Opportunities for U.S. Companies**

Although relatively high transportation costs make manufactured goods exported from the United States to China more expensive, U.S. companies can find success exporting high value-added products. As products are commoditized, the opportunity to export from the United States decreases substantially.<sup>32</sup>

U.S. exporters are encouraged to view the Chinese renewable energy market by region or province, with each distinct location offering different opportunities. The resource-rich west, including Xinjiang, Qinghai, and Gansu, has been targeted by the Chinese

Government for increased renewable energy development and will likely be the location of many projects going forward.<sup>33</sup>

The eastern and southern manufacturing centers, while not the location of most renewable energy projects, are often where component manufacturers and developers can find buyers for their products and services. The third region, the transmission-constrained north, may be an area for distributed generation, but at this point should not be targeted as a region of particular potential for U.S. exporters.

### Solar

China is already the largest producer of solar technologies globally, supplying not only its own market, but roughly 70 percent of global PV cell and module demand.<sup>34</sup> It became the world's largest consumer of solar products as well in 2013, with continued growth projected well into the future.

China plans to add 17.8 GW of new solar capacity in 2015, according to the National Energy Administration. It installed 13.5 GW of capacity in 2014 – more than any country has ever installed in a single year. But growth is just beginning. According to *Bloomberg New Energy Finance*, China will install roughly 27 GW of new capacity annually by 2020.<sup>35</sup>

While CSP growth has been limited to date, China's National Development and Reform Commission is expected to announce a Feed-in-Tariff rate for CSP in 2015 or 2016, which should drive investment. ITA also anticipates a burgeoning distributed PV market following a forthcoming announcement by its National Energy Administration that will update the country's incentives for roof-mounted solar.<sup>36</sup>

### Wind

China's vast wind market and an unprecedented investment in the sector should support considerable exports from the United States through both 2016 and 2020. As a result, China ranks second on ITA's list of largest projected near-term wind export markets. The country maintains a complete wind supply chain, but often imports or licenses critical components for the wind industry.

As the country shifts towards small- and medium-sized wind farms, increased technical and safety standards, newer technologies, and the demand for innovative products and technical components may provide opportunities for U.S. exporters, although competition

will be fierce.<sup>37</sup> Chinese buyers often base their purchasing decisions on upfront price, reducing the competitive position of U.S. suppliers, which win based on long-term quality and lifetime cost.

Despite initial industry excitement over a potential Chinese offshore wind market, ITA does not expect large-scale development through 2020. In June 2014, China's National Development and Reform Commission (NDRC) released its long-awaited feed-in-tariff for offshore wind, but the new scheme offered prices that were the lowest in the world, making other offshore markets far more attractive.<sup>38</sup>

#### Hydropower

U.S. exporters may find some opportunities in the design, engineering, and development of hydropower projects in China. Hydropower has always been a priority for China's infrastructure investment funds, and approval for projects is relatively easy compared to other markets.

China has the largest hydropower resource potential in the world and the largest number of projects in its pipeline, which is estimated at 16 projects with 80 GW of expected capacity.<sup>39</sup> Most projects are likely to be constructed in the Southeastern provinces of Yunnan and Sichuan.<sup>40</sup> While domestic companies should dominate the market, U.S. exporters may find opportunities selling expertise, control systems, and environmental consultancy services.

#### Geothermal

China ranks 19<sup>th</sup> on ITA's list of top projected geothermal export markets over the near-term. ITA does not expect significant development, with most projects under development in the experimental phase. Over the medium-term, some geothermal development is possible and U.S. companies would likely compete effectively, if these projects materialize.

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# India

Type: Large Market; Small Market Share

For the first time in years, India's renewable energy goals appear obtainable. The election of Prime Minister Narendra Modi, who has overseen a significant renewable energy program in Gujarat, portends reforms that should facilitate investment in the sector and promote increased deployment across a range of technologies. U.S. exporters, however, have found the Indian market frustrating, and are often perplexed by bureaucratic obstacles and local content requirements (LCRs.)

Sector Rankings		Overall Rankings
Geothermal N/A	Hydropower 8	Near-Term 7
Solar 2	Wind 24	Mid-Term 9

India is already one of the world's largest renewable energy markets and a new national government commitment to clean energy should facilitate growth over both the short and medium-term. According to ITA's projections, only three markets will install more renewable energy capacity through 2016 than India – China, Japan, and Germany. Only two of these markets (China and Japan) will install more capacity over the medium-term (through 2020).

In 2014, India elected Narendra Modi in a sweeping election that carried with it a broad mandate to improve India's power sector. Modi has a strong track record of developing renewable energy from his time as chief minister in Gujarat and early signs indicate that he will continue to support clean energy development during his time as Prime Minister.

The Modi administration's largest and most perplexing challenge is arguably India's significant need for power. Rolling brownouts have hampered economic growth and limited foreign investment in the country. The July 2012 blackout that affected 620 million people, for example, was seen as a global embarrassment and remains a politically contentious topic to this day.<sup>41</sup>

Upon entering office, Modi reiterated his campaign pledge to ensure 24/7 power for all Indians. Given India's ongoing difficulties in traditional power generation, new renewable energy investment will likely need to be relied on to meet this commitment. While significant development is expected in the wind and hydropower sectors, solar is expected to play the most important role in India's power mix going forward

– both as a result of falling solar prices and Prime Minister Modi's history with the technology.

## Overview of the Renewable Energy Market

ITA expects renewable energy projects in India to be developed and commissioned at a higher rate beginning in 2015, as the market responds to positive steps by the Modi government to encourage investment and make projects more attractive. In particular, new financing mechanisms announced by India in 2014 should increase both investment and installed capacity, perhaps leading to India meeting its installation goals for both wind and solar – something previously thought impossible before the reforms.

The July 2014 budget proposed by Prime Minister Modi even included a doubling of the tax on coal, which will generate an estimated \$1.1 billion to fund several important clean energy subsidies.<sup>42</sup> The budget also included a new proposal to offer a 10-year tax holiday to power companies that begin operations in India by 2017.<sup>43</sup> While this may provide an incentive for American exporters to open manufacturing facilities in India, it also might put more capital in the hands of existing manufacturers who can then purchase U.S. technology or services.

Following the budget declaration, India's finance minister announced that Indian banks would be allowed to raise long-term funds for lending to the infrastructure sector through the easing of constraints on liquidity, cash reserves, and priority lending.<sup>44</sup> This should support additional investment in renewable energy development, as well as the grid infrastructure

needed to move renewable electricity produced in rural areas to load centers around the country.

At this stage, the new Modi Government even appears willing to allow some foreign imports in an effort to stimulate investment and deploy technology more quickly. Despite the Directorate General for Anti-Dumping and Allied Duties conclusion that PV cells and modules were being dumped in the market by China, Taiwan, Malaysia, and the United States, the Ministry of Finance announced that it would not institute duties to keep prices low for Indian consumers. The announcement was met with considerable support from the global solar industry and should ensure some level of U.S. competitiveness in the sector, particularly in the supply of technology to projects backed by state-level incentives that do not require local content.

In November 2014, India again garnered international support by announcing it would dramatically increase its solar energy targets to 100 GW by 2019 (previously the National Solar Mission had targeted by 22 GW by 2022) and 40 FGW of wind by 2019. While ITA does not expect India to meet these targets, the ambitious nature of their announcement sends a positive signal to the market of India's willingness to use its policy tools to drive development.

### **Challenges and Barriers to Renewable Energy Exports**

While many positive developments do suggest growing U.S. export competitiveness in India, exporters face two important challenges – one economy-wide and the other specific to renewable energy. First, exporters must engage with a slow, often overly bureaucratic regulatory system that includes highly regulated electricity prices and inefficient state-owned distribution companies. Developers of all power generation technologies face the same hurdles, which can slow development and make investment decisions less attractive.

Second, U.S. exporters, particularly those in the solar sector, continue to face a local content regime that is the most stringent of any employed globally. Phase 1 of the Jawaharlal Nehru National Solar Mission (JNNSM), India's flagship solar incentive program, banned the use of imported crystalline-silicon solar cells in JNNSM projects (the ban was later extended to include modules). Phase 2 of the JNNSM, which is ongoing, reserved half of the 750 MW auctions for developers who use only Indian-made content.<sup>45</sup>

While thin-film suppliers could provide technology to the market under Phase I, the bifurcated nature of the Phase II auctions limits them to just 350 MW of available projects. Under the Phase II guidelines, solar developers can request Viability Gap Funding to support projects that fall short of financial viability. Interestingly, developers using the portion of the JNNSM that requires local content requested twice as much VGF funding than those able to source product on international markets.<sup>46</sup>

### **Opportunities for U.S. Companies**

The size of the Indian renewable energy market should drive export growth, as should the surprisingly high market share enjoyed by U.S. suppliers, which have often benefited from the presence of the U.S. Export-Import Bank in the country. As such, India moved up eight places to number seven on this year's *Top Markets Report*.

Like other large markets, exporters and policy-makers are well served to consider distinct regions or states as different opportunities. Karnataka and Tamil Nadu, in India's far south, enjoy strong regional clusters of wind, solar, and hydropower companies and thus can be good destinations for export promotion activities. Gujarat and Rajasthan have excellent wind and solar resources and a history of successful clean energy projects. India's northern and eastern states do not offer strong resource potential and future development there is unlikely.

#### Wind

India's wind supply chain remains extensive, with local companies dominating the market. In fact, India enjoys 10 GW of wind turbine manufacturing capacity – three times its domestic demand, making it a key exporter to the international turbine market.<sup>47</sup> The restoration of accelerated depreciation benefits in July 2014, which had supported wind investment in the past, should increase funding for the sector and accelerate development in the years ahead.<sup>48</sup>

American exporters unfortunately can expect to be at a severe disadvantage. According to ITA projections, less than one percent of the Indian wind import market will be captured by U.S. exports. U.S. companies may find some opportunities exporting component parts, as India does not charge an import duty for wind turbine components and exporters like AMSC, for example, have successfully licensed wind turbine technology for years.<sup>49</sup>

Importantly, the Indian offshore market appears to be gaining momentum. In October 2014, the Indian Government announced the first offshore wind project off the coast of Gujarat. The project will receive financial support from the government and will be developed by Suzlon, India's largest turbine manufacturer.<sup>50</sup> It is expected that the project will begin construction in 2015 with future projects likely to be announced shortly thereafter.

#### Solar

While LCRs limit the opportunity for Indian buyers and project developers to source technology on international markets, some solar technologies are imported. Of these, U.S. exporters capture a surprisingly high market share. In fact, U.S. exporters are projected to capture nearly 12 percent of India's import market – more than double the share captured globally by U.S.-based suppliers and nearly ten-times more market

share than what is expected in China. India therefore ranks second on ITA's list of top solar export markets in the short-term (it falls to fourth over the medium-term). In particular, exporters may find opportunities to supply wafers or polysilicon to Indian buyers, as the market maintains almost no production capability in these technologies.

#### Hydropower

With a fully developed hydropower supply chain, 39 GW of installed capacity, and nearly 80 GW of planned development, the Indian hydropower market remains both mature and difficult to enter for U.S. firms.

#### Geothermal

ITA does not foresee any significant geothermal development in the short-term, although some geothermal heat pump activity is possible. In the medium-term, a few power generation projects are possible, although large scale development is unlikely.

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# Japan

Type: Large Market; Small Market Share

Only China will install more renewable energy capacity over the next two years than Japan. However, likely policy reforms make longer-term export projections less clear. While acknowledging some downside risk, ITA nonetheless remains bullish on the ability of the Japanese market to support U.S. exports, despite a persistent lack of market share captured by U.S. suppliers. Successful exporters often enjoy strong partnerships with Japanese conglomerates, who have traditionally dominated the market. While these firms manufacture most products themselves, American suppliers can help fill gaps in Japan's supply chain.

Sector Rankings		Overall Rankings
Geothermal	Hydropower	Near-Term
10	37	2
Solar	Wind	Mid-Term
1	27	3

Since the earthquake and tsunami that destroyed the Fukushima Daiichi nuclear plant in 2011, Japan's power sector has been marked by significant turmoil. Almost immediately, Japan switched off its nuclear reactors, creating an important and unprecedented opportunity for renewable energy developers.

While the Japanese renewable energy market has always been important, the decision to use policy incentives to adjust its energy mix meant that growth was all-but-assured. Over the last three years these early projections were borne out and today, Japan is one of the world's largest markets with significant growth projected well into the future.

Demand has been so strong for renewable energy equipment that U.S. companies, despite a historic lack of market share, have often found a greater interest in their products. ITA expects this to continue, particularly in the solar industry, where the extent of Japan's investment should create important export opportunities for many U.S. suppliers. As a result, Japan moves up 15 spots in this year's *Top Markets Report* – more than any other country previously ranked in the top 50. Over the next two years, ITA expects Japan to support roughly 15 percent of all U.S. renewable energy exports – and more than one-third of all solar exports.

However, ITA notes some downside risk to these projections, particularly in the medium-term, due to potential policy changes that could restrict growth in the clean energy sector post-2015. In particular, the reelection of Prime Minister Shinzo Abe in December

2014 strengthened the hand of those calling for the restart of a major share of Japan's nuclear fleet, potentially limiting future renewable energy development.

Prime Minister Abe is a clear advocate for the nuclear industry and seems to have sided with Japan's ten vertically-integrated and politically-important electric utilities, who have argued forcefully for the right to curtail renewable energy deployed on their grids. As a result, ITA expects nuclear restarts in 2015 and 2016, coupled with a weakening of renewable energy incentives. Longer-term, electricity market reform may create new interest in distributed PV systems, further transforming the market.

## Overview of the Renewable Energy Market

While previously supported through targets and some tax incentives, Japan's clean energy push was substantially improved with the launch of a feed-in-tariff (FIT) regime in July 2012. Almost immediately international investors and developers flocked to the market, making it one of the most attractive in the world. In the months that followed, almost every major renewable energy manufacturer had either signed an agreement with a Japanese conglomerate to supply the market, or was seeking to enter the market under its own label.

In the year following the introduction of the FIT, Japan approved a staggering 23.6 GW of new renewable energy capacity<sup>51</sup>; today, 13 GW of that approved is online.<sup>52</sup> The vast majority of this project pipeline,

which is still growing, is in the solar sector, but wind, hydropower, biomass, and geothermal projects have also been approved.

Despite an almost ten percent reduction in the solar FIT in April 2013, a further 11 percent reduction in 2014, and another 16 percent FIT reduction in 2015, the rate is still relatively attractive to investors and developers.<sup>53</sup> While these changes make longer-term projections more challenging, ITA does not expect any reduction to be so great that it would significantly weaken investment in the market. Changes will likely be felt at the fringes of the Japanese market, with new or innovative projects likely becoming non-viable before traditional or more investable projects.

### **Challenges and Barriers to Renewable Energy Exports**

Despite the size of the Japanese market and the near-term export opportunity associated with continued investment in the sector, renewable energy exports are limited by the persistent lack of market share captured by U.S. suppliers. According to ITA's projections, U.S. exporters will capture just over two percent of the Japanese import market. Since a large portion of Japan's overall demand for clean energy projects will be met by domestic suppliers, the share of the overall market supplied by U.S. firms is even lower.

Moreover, questions remain as to whether all the approved projects will be fully commissioned. Changes to grid connection and curtailment rules in 2015 could make renewable energy projects more difficult to finance and construct.

The new rules are expected to allow Japan's utilities to reject previously approved renewable energy projects and stop accepting renewable power generating at existing facilities for up to 30 days a year without compensation.<sup>54</sup> In many ways, these changes are far more troubling than changes to the FIT rates, as they impact previously installed projects and could reduce or even eliminate the profitability of some assets. Longer-term electricity market reform – once politically unpalatable – now appears more likely. With so much renewable energy already online and Japanese consumers gaining a comfort with distributed generation, we believe Japan's market will ultimately be opened up to third-party power production, a sentiment furthered by strong statements of support from Japanese decision-makers.

Any reforms that create an opportunity for independent power producers (IPPs) to compete effectively with Japan's electric utilities should favor additional clean energy development and would likely create new buyers for U.S. exporters to sell to.

### **Opportunities for U.S. Companies**

In April 2014, Japan's Cabinet approved the country's first Basic Energy Plan since the Fukushima disaster. In it the Government calls for Japan to surpass its previous targets of 13.5 percent power generation from renewable sources by 2020 and 20 percent by 2030.<sup>55</sup> While opportunities should exist in every clean energy sector, ITA projects the most promising and most valuable opportunities in the solar sector.

#### Solar

Japan ranks first on ITA's list of top solar export markets through 2016 – up from eighth in last year's *Report*. The market does not impose any local content policies or import tariffs and thus U.S. exporters benefit from a market in which they can compete fairly with foreign and domestic suppliers.

Nonetheless, intense competition from lower cost suppliers elsewhere in Asia continues to limit the share of the solar import market captured by U.S. exporters. Chinese, Korean, and Taiwanese firms have all captured a significant share of the import market and many of these firms have partnered successfully with Japanese distributors, making further market penetration difficult for American manufacturers.

Many domestic Japanese firms that produce technology abroad for other markets have also begun shipping products back to Japan from their facilities elsewhere. Sharp and Kyocera, for example, now ship solar products from Mexico and Eastern Europe back to Japan.<sup>56</sup>

U.S. firms may find a willing partner with Japanese manufacturers not currently involved in the solar sector. Many of these firms appear to be taking steps to either enter the solar market for the first time or to deploy more resources to growing their solar business. Licensing solar technologies to these conglomerates or providing equipment to manufacture solar panels could be two areas of potential export growth to this market segment.

A further opportunity may result from the sharing of best practices associated with financing off-grid solar

systems in the United States. In particular, solar leasing arrangements may find a ready market in Japan thanks to the country's well established financial sector and growing demand for roof-mounted PV.

#### Wind

U.S. exports in the wind sector are expected to be limited to niche opportunities, as the United States enjoys very little market share in Japan. Anecdotal evidence suggests that small wind turbines, for example, may provide an opportunity for American companies to compete.

#### Geothermal

Estimates indicate that Japan has the third most geothermal potential of any country in the world, ranking behind the United States and Indonesia (15.7 GW of geothermal potential).<sup>57</sup> Due to permitting and land use issues (most of the best geothermal spots are near national parks), however, almost none of this potential has been developed – only 537 MW.

Japan's need to produce baseload power suggests that this resource can no longer be ignored. Japan may begin to revise its environmental regulations over the next several years to enable greater use of its geothermal resources. While no megaprojects are expected to be constructed through 2016,<sup>58</sup> exports of equipment and services may be possible in the surveying, drilling, and resource assessment sectors.

#### Hydropower

Japan's hydropower market is expected to be limited through 2016 with only modest export growth projected into the future. Small hydro FIT rates have facilitated the approval of several small hydropower projects.<sup>59</sup> As these projects are developed, U.S. firms may find some opportunities exporting hydropower services, like environmental assessment consulting or engineering expertise. Most hydro products, however, are expected to be procured locally.<sup>60</sup>

In the medium-term, Japan is expected to develop more hydropower, as it seeks to develop new baseload electricity sources. Should the nuclear industry experience a renaissance in Japan, additional hydropower development would likely be limited.

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# Mexico

Type: Large Market; Small Market Share

Ongoing energy sector reforms make projecting renewable energy export to Mexico challenging. However, based on Mexico's proximity to the United States, ITA notes considerable upside export potential. Mexico's proximity to the United States and its strong renewable energy resource base make it an appealing market for many American exporters. U.S. firms are encouraged to participate in the Mexican market, working with local colleagues to both shape the new regulatory environment and benefit from an important first-mover advantage.

Sector Rankings		Overall Rankings
Geothermal 5	Hydropower 7	Near-Term 5
Solar 11	Wind 4	Mid-Term 6

Mexico is key destination for U.S. renewable energy exports already, ranking 5<sup>th</sup> on ITA's list of top export markets through 2016. It is in the top 11 markets for each of the four technology subsectors covered in the report. Exporters are often closely connected with firms on the other side of the boarder, with renewable energy goods typically crossing the border several times before they become finished products.

Mexico falls to a disappointing 11<sup>th</sup> on ITA's list of medium-term export markets. However, because of Mexico's proximity to the United States and its world-class wind, solar, and geothermal potential, ITA notes significant upside potential for investment. Should Mexico develop a strong and thriving clean energy market, it is likely that no other market would support more U.S. exports. Accomplishing this goal would improve the region's energy security, help address climate change – a priority for the Mexican Government.

## Overview of the Renewable Energy Market

ITA's outlook for the Mexican renewable energy market has improved since last year due to the widespread and ongoing energy reforms passed into law in August 2014. Although the reform package was largely focused on PEMEX, Mexico's state-run oil company, and was designed to facilitate foreign investment in unconventional oil and gas development, the law should positively impact Mexico's entire power sector, including renewables, when fully implemented in 2016.

The law, which was passed as a series of amendments, was designed to liberalize the electricity generation market; open future development to private firms; and create competition between energy producers. Previously, the majority of Mexico's electricity was generated by the Federal Electricity Commission (CFE), Mexico's state-owned utility company. The reform package created an independent grid operator (CENACE) who controls a new, wholesale market and enables customers to purchase power directly from producers, creating an independent power producer (IPP) market for the first time in Mexico.

The reforms also mandate the creation of a clean energy certification scheme – to be administered by Mexico's Energy Regulatory Commission (CRE) – as the primary mechanism for encouraging the development of clean energy capacity, though the overall effectiveness of this program will depend on details that have yet to be announced.

Exporters are highly encouraged to monitor developments of the energy reform effort closely for opportunities to position themselves for success in the market, as early adopters to the reform regulations may be able to capture new opportunities. In particular, off-grid or roof-mounted solar development appears far more likely after the reforms – a technology that could support significant U.S. exports.

Further buttressing Mexico's clean energy development is the country's "General Law on Climate Change" enacted in June 2012. The law affirmed Mexico's target to increase its electricity generated from clean energy

sources to 35 percent by 2024; and set a national goal to reduce greenhouse gas emissions by 30 percent by the end of the decade.

Partly as a result of these laws, investment in Mexico's renewable energy sector has increased sharply, rising from just \$532 million in 2011 to \$2.4 billion in 2014. Most international investment in Mexico's renewable energy market has historically supported wind development, but solar, small hydropower, and geothermal firms have also benefited.

The continued investment in the sector indicates that global financiers believe that future development of Mexico's renewable energy market is expected, despite ongoing policy changes. While the reform package should allow private and public generators to compete for market share in the power sector, the Mexican Government has not finalized how the new contract schemes will function. Until details are released, it is unclear how renewable energy projects will fare vis-à-vis other fossil fuel projects, or between those developed by CFE and those financed by third-party investors.

The forthcoming decisions of Mexico's energy reform will thus greatly impact the competitiveness of different clean energy technologies. Most industry analysts believe that wind power will continue to dominate the renewable energy market in Mexico regardless of changes to regulation. But greater opportunities for consumers to produce their own power may create additional solar opportunities, particularly as the price of solar continues to fall. Over the medium-term, ITA expects some hydropower and geothermal development, particularly after a geothermal law was enacted in July 2014.

### **Challenges and Barriers to Renewable Energy Exports**

Many of the challenges associated with the Mexican market impact U.S. suppliers in the same manner as suppliers from other markets – namely, an unclear and changing regulatory environment, a reduction in federal government spending on the sector, and a national focus on oil and gas development, which may change with falling fossil fuel prices.

To date, almost all renewable energy development was either approved or purchased directly by the Mexican Government. As a result, negotiating power resided almost exclusively in the hands of the government and prices offered to developers were often far below those

offered in other markets, rendering Mexico an unattractive market for most clean energy developers.<sup>61</sup>

As the market evolves and the influence of the Mexican Government declines, opportunities for developers and investors to considerable solar potential in the North, wind potential in Oaxaca and Baja California, and geothermal potential throughout the country.

Importantly, it is the policies that are created and institutionalized today that will drive investment decisions for years to come. Throughout the reform process, direct interaction between U.S. companies and the Mexican authorities is critical.

### **Opportunities for U.S. Companies**

Mexico's proximity to the United States means that most companies that manufacture domestically, whether U.S. headquartered or not, will export from their U.S. facilities to projects in Mexico. This presents a unique opportunity that should not be underestimated.

#### Wind

ITA expects wind energy to be the dominant player in Mexico's renewable energy market for the foreseeable future. Wind projects continue to command a large portion of clean energy investment in Mexico, attracting over \$1 billion alone last year, nearly half of total clean energy investment within the country. The Mexican Wind Power Association, CFE and SENER announced in January investments for \$14 billion by 2018, an increase in almost 7,000 MW for a total of 9,500 MW of installed wind energy.

Mexico currently lacks a full wind supply chain, indicating that any future development will require imports. Many component parts will be shipped from the United States if a foreign turbine manufacturer ultimately supplies a project. As such, Mexico ranks fourth on ITA's list of top wind export markets through 2016.

#### Solar

Mexico's solar industry remains in its infancy. ITA expects the industry to emerge over the next six years, installing 613 MW of new capacity, primarily through distributed PV. The market is already valued at \$2.3 billion, and investment should increase once the new energy reforms are implemented. In fact, falling solar prices and high capacity factors should make the industry far more competitive going forward and for

consumers located in remote areas, could become the energy source of choice.

#### Geothermal

2014 was a notable year for the geothermal industry in Mexico, as new regulations were signed by President Pena Nieto. A framework is now in place to facilitate the issuance of permits for site study, as well as concessions for exploration and development of geothermal resources. In addition, Mexico's Ministry of Energy (SENER) recently announced that it has partnered with Nacional Financiers and the Inter-American Development Bank to provide risk mitigation and financing for private geothermal energy projects.

ITA projects U.S. exporters will capture nearly two-thirds of Mexico's geothermal imports. Several U.S.

firms are active in the market already, and benefit from Mexico's incomplete supply chain. Opportunities are likely to include operation and management, as well as engineering and drilling services.

#### Hydropower

Development in the hydropower sector will likely be focused on the small hydro industry, where U.S. exporters may find opportunities providing environmental consulting and engineering services to a relatively small and stagnant industry. In the medium-term, ITA expects some larger hydropower projects to come online, although U.S. exporters will only marginally benefit from this development, capturing less than two percent of the import market.

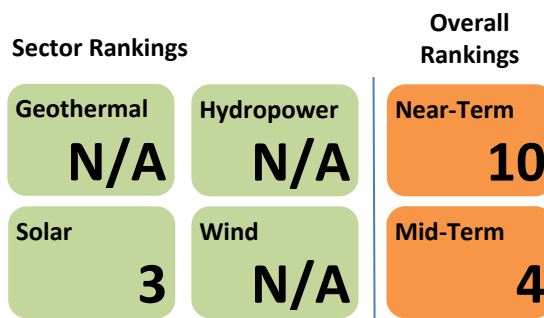
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# Saudi Arabia

Type: Small Market; Large Market Share

While almost no U.S. exports have occurred to date, Saudi Arabia appears on the verge of becoming a key export destination for many U.S. suppliers. The market, however, has been “the next big market” for some time. Nevertheless, in 2015 and beyond, ITA expects Saudi Arabia to take the first steps to achieving its clean energy goals, but notes that its rankings are based on assumed policy implementation which may inflate our projections.



Saudi Arabia will be principally a solar export market, although some development is possible in other sectors. Despite almost no development thus far, the country offers one of the world’s most appealing resources bases, particularly for solar development and plans to install a staggering 54 GW of new renewable power by 2032.<sup>62</sup>

Because almost no global solar manufacturers operate in Saudi Arabia today, growth in the sector would need to be supported almost exclusively by imports, particularly in the short-term. In turn, this should create an important opportunity for several U.S. suppliers. As a result, Saudi Arabia ranks 10<sup>th</sup> on ITA list of top renewable energy export markets in the near-term – and fourth in the medium-term. It ranks third in terms of solar exports, which will account for nearly all exports over both the short and medium-term.

Proven crude oil and natural gas reserves, as well as generous subsidies, have driven energy demand growth over the last several decades (fossil fuel extraction is highly energy intensive). Today, nearly all of Saudi Arabia’s electricity is produced by fossil fuels, leaving enormous wind and solar potential undeveloped.

According to some estimates, the Saudi Arabia now spends 70 percent of its national budget on energy subsidies, motivating a clear desire to diversify the country’s energy supply.<sup>63</sup> Moreover, the Saudi Government has sought to reduce its dependence on fossil fuels – not out of a need to address climate change, but so it can export more fossil fuels.

In 2012, the King Abdullah City for Atomic and Renewable Energy (KACARE) released Saudi Arabia’s National Energy Plan, which noted that the Kingdom would meet its 54 GW goal by developing 16 GW of solar PV, 25 GW of solar thermal, and 9 GW of new wind power.<sup>64</sup> An initial tender for 800 MW of new renewable power was to be introduced a month after the energy plans release followed by two more tenders totaling 6.9 GW in 2015.<sup>65</sup> To date, the program is well behind schedule and no tenders have been released, causing great frustration for many would-be suppliers.

Nevertheless, given recent positive announcements from the Saudi Government and industry assessments of the opportunity, ITA expects the Kingdom to install 1.8 GW of new renewable energy by 2016 and nearly 10 GW by 2020. However, ITA notes considerable downside risk to these projections. With no track record of success, it remains to be seen if KACARE or another Saudi entity can foster the investment needed to meet the Kingdom’s goals.

The projections are also hindered by the changing price of oil on global markets. As the region’s largest producer and supplier of fossil fuels, low international prices will have an important and potentially debilitating impact on Saudi Arabia’s national budget. As such, investments in new renewable energy - which are not needed, but rather wanted, by the Kingdom’s leadership – may be delayed. As no policy change has occurred to date, ITA maintains its projections, but notes that any amendment or delay in upcoming solar tenders will dramatically reduce projections for the market.

## Overview of the Renewable Energy Market

U.S. exporters should begin to see progress in the Saudi renewable energy market this year. In September 2014, the Saudi Government announced its intention to build solar power plants in five different regions by the end of 2015. The sites were identified as Dawaser (Riyadh), Mahd Al-Dahab (Madinah), and Sharourah (Najran).<sup>66</sup> Completion of the five projects on time will help gauge whether the market is ready to achieve its significant policy goals.

The abundant and substantial electricity subsidies employed by the Saudi Government have made large scale renewable energy development uncompetitive. In fact, renewable energy will likely continue to be highly government-driven in Saudi Arabia long after it reaches grid parity in other markets.

## Challenges and Barriers to Renewable Energy Exports

A further concern is the presence of potentially severe local content requirements. In its White Paper on the subject, KACARE noted that forthcoming tenders for solar projects would include an evaluation of each developer's support for local companies permanently based in Saudi Arabia. According to the plan, developers will be required to submit each project's localization impact two years after operations begin. Any developer that does not meet the minimum requirement for local content will be ineligible for future tenders. Within each technology class, developers falling in the bottom 20 percent of job localization will be penalized a certain amount per non-Saudi employee.<sup>67</sup> These stipulations, if implemented, are significantly troubling for potential U.S. export competitiveness in the market.

## Opportunities for U.S. Companies

As a wealthy economy with considerable renewable energy resource potential, any future development will enjoy relatively easy access to financial support. The International Finance Committee (IFC), the World Bank's private-sector arm, for example, recently announced it would invest \$100 million in a local Saudi developer, seeking to support their efforts at building clean energy projects in the country.<sup>68</sup>

### Solar

Saudi Arabia ranks third on ITA's list of top solar export markets to 2016, and moves up to second over the medium-term.

Given the subsidized nature of Saudi retail electricity prices, little incentive exists for households or business to invest in roof-mounted solar PV systems. As a result, ITA expects most – if not all – solar development in Saudi Arabia to be in the form of utility-scale projects.

Without local content requirements keeping U.S.-made equipment out of the market, ITA believes U.S. companies would be well positioned to find export deals. Unlike other markets where U.S. exporters often lose to lower-cost/lower-quality alternatives from other suppliers, the Saudis have demonstrated a clear interest in cutting-edge, innovative technologies in which the United States excels.

Moreover, Saudi Arabia offers a potentially transformative concentrated solar power (CSP) market. If achieved, or even approached, the 25 GW of new solar thermal power called for in the 2012 National Energy Plan, would turn the market into a catalyst for this relatively new technology. CSP is ideal for Saudi Arabia's climate and population. It requires consistent sunlight and large areas of open spaces -- two things Saudi Arabia clearly offers.

### Hydropower

ITA does not anticipate hydropower development in Saudi Arabia in either the short-or-medium-term.

### Geothermal

The original announcement from KACARE that described Saudi's clean energy development goals noted 1 GW of new geothermal development, although no progress has been made on this commitment to date. ITA does not anticipate any development in either the short or medium-term. Some exports are possible in the early exploration phase of geothermal development, particularly site assessment and early-stage engineering.

### Wind

Little or no development is expected in Saudi Arabia's wind sector despite the original commitment from KACARE to tender 100 MW of wind in 2013. All indications are that future development will be focused on the solar sector.

However, Saudi Arabia does enjoy good wind speeds in the Southeast, making some potential development possible. It is unlikely that any development in this region would be supplied by U.S.-made equipment.

### **Sector Snapshots**

This section contains sector snapshots that summarize U.S. renewable energy export opportunities in each subsector. The overviews outline ITA's analysis of the export potential across each technology's supply chain. The snapshots provide subsector rankings and describe the different types of markets that U.S. exporters must sell into. Finally, each snapshot offers commentary on the relative competitive position of U.S. suppliers.

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## Geothermal Energy

**The United States has long been the world's leading geothermal industry. Most U.S. firms, however, have looked abroad for export opportunities only occasionally. In 2014 this changed, as domestic policy uncertainty slowed growth at home and new developments overseas shifted attention to lucrative export opportunities. While ITA expects other renewable energy sectors to deploy more technology over both the short-and-medium term, the industry's considerable market share, should position geothermal exporters for success in international markets.**

Evidence of a potential geothermal resurgence began to emerge in 2014. The market is defined by large potential markets that are home to significant untapped resource potential. As these markets grow, the geothermal industry's ability to produce baseload electricity should become increasingly attractive.

### U.S. Geothermal Industry Export Base

The United States enjoys a strong and stable geothermal supply chain, with expertise in project development, engineering, geothermal resource assessment, and component part manufacturing. U.S. companies are particularly adept at drilling geothermal wells, as several firms active in oil and gas exploration often crossover to support geothermal development.

ITA expects the United States to capture over one-third of all non-U.S. imports – a far greater market share than any other renewable energy sector. In fact, demand for U.S.-made products and services should increase through both the short and medium-term.

### Overview of Global Export Market Opportunities

For the first time, growth in the geothermal market outside the United States is set to eclipse U.S. growth. Indonesia, for example, has 3 GW of projects in its pipeline and Kenya, which again ranks #1 on ITA's list of top geothermal export markets, has a national target of 1.8 GW of new geothermal development by 2016.<sup>69</sup> Geothermal energy offers these countries a primary source of electricity that is key to both economic growth goals and low-carbon development strategies.

The sector's near-term development should support \$3.4 billion worth of geothermal equipment imports outside the United States. Since geothermal-related services account for a large share of a project's overall cost, the total number of imports in the sector will likely be far higher. And because U.S. companies enjoy a strong market share – more than 38 percent, according

to ITA's projections – this development should strongly support U.S. exports.

Importantly, unlike other renewable energy sectors where project development is both quicker and more consistent, many announced geothermal projects never reach completion. Instead, projects are often abandoned out of resource concerns, a lack of policy support, or development opportunities that occur elsewhere. *Bloomberg New Energy Finance* notes that less than half of the geothermal capacity planned to be online between 2015 and 2017 will likely never be fully commissioned.<sup>70</sup> As such, export projections in the sector are notoriously unreliable.

**Figure 1: Near-Term Geothermal Export Markets (2015-2016)**

- 1. Kenya**  
(large market; large share)
- 2. Indonesia**  
(large market; large share)
- 3. New Zealand**  
(small market; small share)
- 4. Turkey**  
(small market; small share)
- 5. Mexico**  
(small market; large share)
- 6. Chile**  
(small market; large share)
- 7. Peru**  
(small market; small share)
- 8. Philippines**  
(small market; small share)
- 9. Nicaragua**  
(small market; large share)
- 10. Japan**  
(large market; small share)

## The Geothermal Export Opportunity in the Near-Term

The geothermal industry is reliant on the availability of naturally occurring geothermal reservoirs and has thus been limited to markets near tectonic fault lines. As a result, the industry's export markets are extremely concentrated, with only the top 10 markets expected to account for 96 percent of all exports in the sector.

Kenya tops ITA's list of projected export markets through 2016, keeping its rank in last year's report. Should Kenya even approach its national target of 1.8 GW of installed geothermal capacity by 2016, it will be the most important export market in the history of the geothermal sector. Fortunately, U.S. exporters have demonstrated a strong ability to compete in the market and would benefit greatly from this development.

Two factors complicate efforts to support exports in the sector. First, while the United States enjoys a large share of the global import market, development of geothermal projects will account for less than 1 percent of total renewable energy capacity growth through 2016 – and even smaller amount through the medium-term, as other sectors attract far more investment.

Second, the only segment of the geothermal industry not dominated by U.S. suppliers is also its fastest growing – “flash” geothermal turbines. Japanese firms (Toshiba, Mitsubishi, and Fuji) have captured roughly two-thirds of the “flash” turbine market.<sup>71</sup> While the choice of turbine is heavily dependent on the geothermal resource being tapped, flash turbines are expected to capture a large share of new geothermal development. Most projects currently under development are greenfield projects at a site that is yet to confirm the expected resource via full diameter deep drilling (the industry standard), but drilling has commenced at those sites that are expected to be “high-grade flash” resources. This may limit the export opportunity for U.S. component providers going forward.

U.S. companies excel in producing “binary” geothermal turbines and to the extent that markets can be encouraged to build “binary” power plants, the more likely U.S. exporters will benefit from that investment.

U.S. drilling companies, however, should be able to find success, though the high utilization of oil and gas rigs in the United States will limit the attractiveness of overseas geothermal projects. Falling oil prices, however, may reduce the likelihood that new oil and gas projects are developed, freeing drilling companies to support additional geothermal development around the world.

U.S. exporters may also find short-term export opportunities in the geothermal heat pump industry. While not considered in the *Top Markets* analysis, demand for geothermal heat pumps appears to be increasing globally with U.S. suppliers enjoying considerable market share.

## Planning for the Long-Term

Over the next two decades, growth in the geothermal market should accelerate globally, as power demand continues to increase worldwide and the cost of production becomes more attractive. There remains considerable untapped potential in several markets, including Central America, Chile, Japan, Indonesia, and Africa. Investment should flow into these markets hesitantly at first but in larger volumes thereafter.

Latin America offers an important opportunity for the geothermal industry. U.S. export competitiveness increases in the region, where ITA projects over half the import market to be met by products manufactured in the United States. Other competitors, however, also see Latin America as a key future export opportunity. Japan's export bank, for example, has signed agreements with lenders in Costa Rica and Bolivia for future geothermal projects, as has Germany's KfW, which signed an agreement with the Development Bank of Latin America for the same purpose.<sup>72</sup>

## Hydropower

**Despite receiving little attention within the United States, the global hydropower industry is poised to install a staggering amount of new capacity by the end of the decade. Unfortunately, the international competitiveness of U.S.-based technology suppliers in the sector remains minimal. Five foreign manufacturers dominate the turbine market, with most development utilizing “large hydropower” technologies, an area of distinct U.S. weakness. U.S. exporters enjoy a more competitive position in the “small hydro” market, particularly when projects are constructed closer to the United States.**

Taken together, large and small hydropower capacity globally exceeds all other renewable energy sources combined. Total installed capacity worldwide now exceeds 800 GW with new large hydro installations occurring almost exclusively in developing markets.

Based on industry projections, ITA expects the global hydropower industry to cumulatively install over 300 GW of new capacity outside the United States between now and the end of the decade. The sector is projected to account for nearly half of all renewable energy development in that time frame.

### U.S. Hydropower Industry Export Base

The United States has the third largest installed hydropower capacity of any country in the world behind China and Brazil.<sup>73</sup> Today, the sector accounts for 79 GW of power capacity in the United States – the second largest source of non-fossil fuel generation behind nuclear power.<sup>74</sup>

Yet since the 1960s, major hydropower development has essentially stopped. The United States has not commissioned a new large hydropower dam in well over a generation. Only three percent of domestic hydropower capacity has been installed since 1990, with just 1 GW of new capacity added since 2000.<sup>75</sup> Most forward-looking domestic capacity growth is expected to occur in the form of efficiency improvements at existing dams and the installation of power generating equipment at small dams that were constructed for some other purpose – i.e., river navigation, flood control, etc.

As a result, the global hydropower industry’s expansion over the next several years will largely occur without the involvement of U.S. exporters. In fact, according to ITA’s projections, U.S. exporters will capture just one percent of the global import market. Anecdotal evidence suggests that this number could be slightly

higher for service exporters, who often compete more effectively overseas.

### Overview of Global Export Market Opportunities

Over the next two years, ITA expects the world to install 44 GW of new hydropower capacity outside the United States, trailing both wind and solar in terms of global development. However, the industry is expected to install 300 GW of new capacity through 2020, with most development occurring in emerging markets – far more than either the wind or solar sectors.

China will account for the vast majority of the world’s investment in large hydropower. Driven by increasing power demand and a need to reduce the carbon

**Figure 1: Near-Term Hydropower Export Markets (2015-2016)**

1. **Canada**  
*(large market; large share)*
2. **Chile**  
*(small market; large share)*
3. **South Africa**  
*(small market; small share)*
4. **Sudan**  
*(large market; small share)*
5. **Spain**  
*(small market; small share)*
6. **Thailand**  
*(large market; small share)*
7. **Mexico**  
*(small market; large share)*
8. **India**  
*(large market; small share)*
9. **Malaysia**  
*(small market; small share)*
10. **Colombia**  
*(large market; small share)*

footprint of its power mix, China is expected to install 132 GW of new hydropower by 2020.

China's growth is largely driven by the construction of several large hydropower facilities. Large hydro receives the lion's share of global investment in the sector, accounting for roughly 85 percent of total new capacity brought online last year.<sup>76</sup> In total, there are currently 44 mega-hydropower plants under development in China, each with more than 1 GW of planned capacity.

Almost all of new large hydropower projects regardless of location will be supplied with turbines from one of five dominant turbine producers.<sup>77</sup> European producers Andritz (Austrian), Alstom (French), and Voith (German) should continue dominate turbine sales outside of China, while Dongfang Electric and Harbin Electric will likely capture almost all turbine contracts in China. As a result, hydropower exports are expected to account for just 22 percent of U.S. clean energy exports through 2016 despite the hydropower industry accounting for 65 percent of the value associated with clean energy development during that time period.

### **The Hydropower Export Opportunity in the Near-Term**

While the United States does not enjoy a competitive position within the large hydro market, the three dominant European turbine suppliers all have some manufacturing capacity in the United States and often export from their U.S. facilities to projects in Canada and Latin America. In fact, despite limited growth compared to other markets, Canada again ranks #1 on ITA's list of projected export markets in the sector, matching its ranking in last year's report.

ITA expects Canada to install roughly 3.7GW of new hydropower capacity over the next two years, with U.S. suppliers capturing roughly 11 percent of the value associated with this development. More than two-thirds of hydropower exports in the near-term are expected to go to Canada, with no other market capturing more than 3.5 percent of total hydropower exports. By contrast, China – the largest hydropower market over both the short-and-medium-term – will account for less than one percent of U.S. exports, and ranks 19<sup>th</sup> in this year's *Top Markets Report* subsector ranking.

Unlike other renewable energy sectors, ITA's hydropower rankings are impacted significantly by the potential construction of one or two massive hydropower projects in certain countries. For example, Sudan ranks #4 on ITA's list of top export markets through 2016, but falls to #10 in the mid-term thanks to one large expected project to be completed in the next two years (a 320 MW dam).

While large hydro projects do not offer U.S. exporters a likely opportunity, the United States does possess a strong small hydro industry (generally defined as supporting projects below 30 MW). The industry often produces power for off-grid communities, small towns along rivers, and generates power from existing dams used for other purposes.

A large slice of the hydropower market is also the addition of existing capacity at existing dam facilities, which often requires considerable engineering expertise. Several U.S. firms excel in this subsector and should benefit from capacity upgrades globally.

### **Planning for the Long-Term**

Over the medium-term, ITA expects Thailand and the United Kingdom to become key players in the hydropower market. Thailand is projected to install 20 GW of new hydropower capacity, trailing only China and Brazil. Though U.S. companies are not well positioned to take advantage of the opportunity, U.S. suppliers enjoy some market share already, indicating that this development should support exports in a sector that often fails to compete successfully abroad.

In the United Kingdom (UK), wave and tidal energy companies should find export opportunities, as development is expected to be strong beginning around 2016. In fact, as full commercialization of wave and tidal energy is achieved (likely towards the end of the decade), several U.S. companies should be able to compete effectively in the UK.

Additionally, many U.S. companies are already developing small run-of-river technologies that are more environmentally sustainable than traditional dams and can produce power for rural, off-grid projects.



## Solar Energy

**ITA expects the solar sector to install more capacity through 2016 worldwide, and account for more U.S. exports than any other renewable energy technology. The industry's economics continue to improve, although trade disputes have shifted investment patterns and threaten to limit access to key export markets. Unfortunately, the United States' share of the global import market continues to be severely hampered by a lack of domestic manufacturing capacity.**

Since 2008, the solar industry has grown rapidly as a source of energy and economic activity, both in the United States and around the world. The sector's growing cost competitiveness and continued technological improvements should continue to support growth well into the future.

The industry, which is decidedly global, involves a wide range of companies, each with different needs, opportunities, and challenges. Companies are often headquartered in one country but operate worldwide, shipping products easily across borders. Large manufacturers typically have supply chains in several countries at once, importing components from many different suppliers at once.

### U.S. Solar Industry Export Base

Of the solar manufacturing firms operating in the United States, more than 90 percent of their capacity resides outside the U.S. market.<sup>78</sup> As a result, the United States maintains only a small share of global manufacturing capacity in the sector – roughly five percent, despite inventing or innovating most solar technologies deployed globally over the last three decades. Unless losses in manufacturing capacity are reversed, this lack of market share will decline further.

While the price of solar technologies should continue to fall due to efficiency improvements and increasing economies of scale, the oversupply of cells and modules that defined the industry in 2011-2013 has waned. Prices have begun to stabilize, although expanded polysilicon production could reduce prices on downstream products, like cells and modules, towards the end of 2015 and beyond.<sup>79</sup> Advances in molten salt energy storage technologies, dry-cooling systems, and improved manufacturing processes should also support further price declines vis-à-vis other renewables and fossil fuel alternatives going forward.<sup>80</sup>

The volatility caused by falling prices has resulted in many closures, mergers, and acquisitions – both in the United States and around the world. The industry's

consolidation, as well as improvements in processes, has left the remaining solar manufacturers more financially secure. Competition for investors, projects, and market share, however, remains fierce.

### Overview of Global Export Market Opportunities

Based on forecasts from Bloomberg New Energy Finance and Business Monitor International, ITA projects the solar industry will install roughly 76 GW of new capacity outside the United States in 2015-2016 – more than any other clean energy technology. The industry should continue its significant development into the medium-term, installing nearly 140 GW of new capacity outside the United States through 2020.

Over the next two years, however, foreign suppliers will

**Figure 1: Near-Term Solar Export Markets (2015-2016)**

1. **Japan**  
*(large market; small share)*
2. **India**  
*(large market; large share)*
3. **Saudi Arabia**  
*(large market; small share)*
4. **Chile**  
*(large market; large share)*
5. **Canada**  
*(small market; large share)*
6. **Germany**  
*(large market; small share)*
7. **China**  
*(large market; small share)*
8. **Ecuador**  
*(small market; large share)*
9. **France**  
*(large market; small share)*
10. **Denmark**  
*(large market; small share)*

meet much of this growth, as the United States is expected to capture just 5.2 percent of the global solar import market. The small U.S. market share is limited by a general lack of domestic manufacturing capacity and the United States' status as a net importer of solar technologies. However recent announcements of U.S. manufacturing capacity expansion from at least seven solar manufacturers may increase this number.

### **The Solar Energy Export Opportunity in the Near-Term**

Through 2016, ITA expects Japan to account for over one-third of all U.S. exports in the sector – more than any other country. Despite installing about 10 GW less solar capacity than China, U.S. exporters are expected to be far more competitive in Japan.

While much smaller markets, U.S. exporters enjoy considerably more market share in the Western Hemisphere. Five markets in the hemisphere rank in the top 20 projected export markets, including Chile (4<sup>th</sup>), Canada (5<sup>th</sup>), Ecuador (8<sup>th</sup>), Mexico (11<sup>th</sup>), and El Salvador (16<sup>th</sup>).

China is expected to install the most solar power through both 2016 and 2020, but U.S. exporters will capture only a small share of the Chinese import.

One important opportunity in the near-term will likely be the export of services, particularly financial and other consultancy services that have changed the way solar power is delivered to customers in the United States. Solar leasing, crowd sourcing, and the use of on-bill repayment, for example, should all improve the attractiveness of distributed PV for customers, with U.S. companies providing the know-how and expertise to finance these projects around the world.

### **Planning for the Long-Term**

ITA expects the solar industry to nearly double its installed non-U.S. capacity by 2020, installing over 140 GW of new capacity by the end of the decade. China is projected to have the largest solar capacity by the end of the decade, followed distantly by Japan, Germany, India, and Saudi Arabia. In most markets, U.S. suppliers will find steep competition from lower-cost manufacturers.

The types of solar technologies deployed in these markets will also change by 2020 with a greater emphasis placed on distributed PV systems. High electricity prices in most countries and decreasing

production costs will converge to make distributed PV systems more economical. While policy barriers, like net-metering restrictions, could hamper growth, demand for roof-mounted PV should be too great for policy-makers to prevent widespread investment, potentially provoking changes to transmission and distribution models.

Importantly, as the solar industry approaches and eventually surpasses grid parity, long-term performance and efficiency should become key differentiating factors between module manufacturers. If the United States can maintain, or even expand, its share of the global solar manufacturing, this dynamic should portend increased in U.S. export competitiveness.

## Wind Energy

**Most U.S. wind energy exports currently are destined for only a small group of markets – namely China, Canada, Mexico, and Brazil. These four markets alone will account for over 70 percent of all wind exports through 2016. Yet, continued global investment in the industry outside traditional markets will very likely increase going forward, broadening export opportunities for U.S.-based suppliers. In fact, through 2020, ITA expects the wind sector to overtake solar as the leading renewable energy exporter, accounting for nearly one-third of all exports in the sector.**

The wind industry is a large and growing sector with a supply chain that produces thousands of component parts as well as a service sector that is increasingly advanced in its use of technology to design turbines, organize wind farms, and map wind potential. Most of the industry is vertically integrated, but deep supply chains have emerged to provide technology and components to the largest turbine manufacturers.

Importantly, policy uncertainty in the United States has begun to encourage U.S. wind component manufacturers to look abroad for export opportunities. Coupled with a near doubling of wind energy capacity installed outside the United States through 2020, this dynamic should allow the wind sector to surpass solar as the leading renewable energy export industry. Despite ongoing logistical challenges and higher labor costs, ITA expects the market share captured by U.S. exporters to increase in the near-term, rising to around eight percent, as products traditionally used to supply local demand are shipped to international buyers instead.

### Overview of Global Export Market Opportunities

The global wind market is in the midst of a recovery after a brief decline in 2013. Orders for nearly all manufacturers have increased year-over-year and turbine prices have stabilized around the world.

According to industry projections, demand should further increase in 2015 before stabilizing slightly in 2016 and beyond. Most demand will be met with locally-sourced products, as the wind industry's preferred method of global expansion has been foreign direct investment. Last year's *Top Markets Report* noted the ongoing shift of the wind energy market towards Asia and other emerging markets and away from traditional European countries.

ITA anticipates this trend to continue to 2016 and accelerate thereafter. China, in particular, will be the focal point of the industry going forward, installing

roughly 27 GW of new capacity between now and the end of 2016. Other key markets will include India, Brazil, Canada, the United Kingdom, Mexico, and Turkey.

The largest four export destinations – China, Canada, Mexico, and Brazil – should account for the majority of all U.S. exports in the sector through 2020, as export markets are expected to remain highly concentrated. One market that should support a surprising number of U.S. exports, however, is Egypt, which jumped to #5 on ITA's list of near-term wind export markets – up from #19 in last year's report. With no domestic production capability, Egypt's planned capacity additions will need to be sourced from elsewhere and U.S. exporters, while not dominant in the market, should find opportunities to export competitively. In fact, ITA projects that U.S. exporters will capture roughly one-fourth of all Egyptian

**Figure 1: Near-Term Wind Export Markets (2015-2016)**

1. **Canada**  
*(large market; large share)*
2. **China**  
*(large market; small share)*
3. **Brazil**  
*(large market; small share)*
4. **Mexico**  
*(large market; large share)*
5. **Egypt**  
*(small market; large share)*
6. **Uruguay**  
*(small market; small share)*
7. **South Africa**  
*(large market; small share)*
8. **Honduras**  
*(large market; small share)*
9. **South Korea**  
*(small market; small share)*
10. **Philippines**  
*(small market; small share)*

wind imports through 2016 – a higher market share than in most markets globally.

### **The Wind Energy Export Opportunity in the Near-Term**

In markets that are large, but which are far from the United States, only component parts and services will likely be exported. In China, for example, where re-powering existing wind farms with new technology has become a priority, American companies that can provide efficiency solutions may find considerable demand for their expertise.

For manufacturers of large component parts, Latin American markets may provide the greatest opportunity, particularly when pairing their technology with ExIm financing. While these markets will not be the largest wind markets, they may provide an attractive cost environment in which to do business due to lower shipping costs.

Two important competitors have emerged in Latin America that policy-makers should consider when helping firms develop an export strategy. First, Chinese manufacturers now compete directly with American firms – a new phenomenon, since Chinese manufacturers have traditionally focused exclusively on China’s domestic market. To compete, U.S. exporters must differentiate between their often higher-cost equipment by focusing on quality.

Second, the largest Latin American market – Brazil – has used local content requirements and high import tariffs to protect and grow its domestic manufacturing base. Today, Brazil has the capability of supplying wind technologies to markets elsewhere in South America, competing for the first time with U.S.-based suppliers. This capability has been limited to date, but will very likely increase, as the Brazilian wind market expands.

If Mexico continues to invest heavily in wind development, it too could become a supplier of low-cost equipment to the region, rivaling both the United States and Brazil. Given the interlinked nature of wind supply chains between Mexico and the United States, this development – while not helpful to export competitiveness – would be far more supportive of export growth than an active and export-minded Brazilian manufacturing sector.

### **Planning for the Long-Term**

ITA expects wind export markets to remain fairly constant through the medium-term. The top five markets are projected to remain the same through both 2016 and 2020 (Canada, China, Brazil, Mexico, and Egypt), although the order should change, with China jumping to #1 thanks to 85 GW of new capacity installations over the next six years.

Policymakers should again consider both the size of a country’s wind energy import market and the share expected to be captured by U.S. exporters. An effective medium-term strategy must also include an understanding of how market is expected to change, particularly as new, more innovative technologies are developed.

Although wind will always be capital intensive, as prices decline, the importance of upfront cost should lessen, creating an opportunity for more efficient, innovative turbines perhaps produced in the United States. It should also create export opportunities for U.S. service providers that specialize in plant design, engineering, and site assessment.

In Latin America, U.S. exporters are expected to capture over 20 percent of the import market. Thus, priority should be given to market development activities in the region. Eliminating or reducing trade barriers in Brazil should be given specific priority, as no market should support more wind exports than Brazil, particularly in the medium-term.<sup>‡</sup> Yet, local content requirements, which are expected to increase through 2016, intensely limit the export opportunity associated with the market.

The offshore wind market will likely continue to be concentrated in Northern European markets – namely, the United Kingdom and Germany – although some growth can be expected in Japan and China. In some ways, low oil prices may actually help offshore development, as there could be less competition for large crane vessels and thus lower development costs.

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<sup>‡</sup> While Brazil is not projected to be the largest wind export market over the medium-term, ITA believes that with policy reforms, the market could become the largest destination of U.S. wind exports.

# Mid-Term Outlook

## U.S. Renewable Energy Exports to 2020

Over the next several decades, renewable energy will begin to rapidly transform the world's electricity mix, fundamentally changing the way economies are powered and creating unprecedented opportunities for U.S. exporters. This first-of-its-kind "Mid-Term Outlook" provides exporters a glimpse of the renewable energy sector through 2020, pointing out challenges to U.S. competitiveness, but also identifying opportunities for additional U.S. exports.

While global demand will accelerate post-2020, the Mid-Term Outlook demonstrates that policy decisions made today will influence and define the sector for years after – both in terms of global demand and export competitiveness. Based on ITA's projections, the mid-term period (2015-2020) will be categorized by inconsistent but impactful growth across regions, with certain countries attracting tremendous investment and others left wanting. These variations will warrant different approaches and programs.

The medium-term period will also be punctuated by a general lack of international market share for U.S.-made goods and services. ITA projects U.S. market share to fall below 2 percent by 2020 unless recent declines in manufacturing capacity are quickly reversed. While exports should increase based on market volume, most American firms will feel less successful, as exporters from other Asian economies benefit more than those from the United States.

Several key factors should converge to create and change the global clean energy market through 2020. Perhaps the most transformative is the continued drop in prices for many renewable energy technologies – not just end-products (solar modules, for example), but across the entire industry supply chain. As ongoing efficiency and manufacturing improvements reduce the costs of these technologies even further, and price volatility and environmental regulations should make renewables far more competitive over the next six years with traditional fossil fuels than at any prior period.

Through 2020, many planned coal-fired power plants will be abandoned globally due to climate policies, and in some markets, even existing coal facilities will be taken offline. The resulting need for power will likely be met by natural gas, renewables or nuclear. In markets with low natural gas prices, coal will more commonly be replaced with gas generation. But in markets with high gas prices renewable energy should become even more

attractive. Civil nuclear growth will be heaviest in just a few markets, with most countries choosing not to develop new nuclear capacity.

ITA expects, perhaps somewhat surprisingly the global hydropower industry will grow more than any other clean energy sector for the remainder of the decade. U.S. exporters, however, will remain largely absent in the industry's global expansion, with the limited exception of U.S. service providers, who may find more credible opportunities. The low-cost and carbon-free nature of hydropower will make the technology attractive to governments around the world that seek reliable electricity, but also must deal with the advancing impacts of climate change.

**Figure 1: Medium-Term Rankings of Renewable Energy Export Markets (2015-2020)**

- 1. Canada**  
*(large market; large share)*
- 2. China**  
*(large market; small share)*
- 3. Japan**  
*(large market; small share)*
- 4. Saudi Arabia**  
*(large market; small share)*
- 5. Brazil**  
*(large market; large share)*
- 6. Mexico**  
*(small market; large share)*
- 7. Thailand**  
*(large market; small share)*
- 8. Chile**  
*(small market; large share)*
- 9. India**  
*(large market; small share)*
- 10. United Kingdom**  
*(large market; small share)*

The solar industry, particularly distributed photovoltaic (PV) technologies, will also experience significant growth globally. While still largely dependent on policy incentives to be competitive, the small-scale nature of the distributed PV market can help consumers deal with higher energy prices without requiring lengthy transmission lines. The impact of more distributed PV systems will require utilities around the world, whose business model is based on stand-alone power plants, to adjust their investment plan and operations.

### Large Regional Variation

As exporters plan both market development and entry strategies, they will need to consider that demand growth and renewable energy investment will be significantly higher in developing economies than in developed ones. The industry's marked shift towards emerging markets will be most pronounced in Asia, where renewables could become cost competitive with fossil fuels by 2020, making policy supports less critical and all-but-guaranteeing growth for years to come.

China, India and Japan alone are expected to support over half of the new renewable energy capacity installed outside the United States over the next six years. These markets are fueled by an insatiable appetite for more electricity (in the case of Japan, the drive for more electricity may be offset by the restart of the country's nuclear power fleet). In more developed economies characterized by flat energy demand growth, renewables will compete more directly with traditional energy sources.

In Europe, renewable energy markets should continue to thrive, but in many ways, the market has moved to faster growing economies. Germany and the United Kingdom are expected to be the largest European renewable energy markets for the remainder of the decade, followed by France and Italy. Most European demand should be met by either locally-produced technologies or cheaper alternatives, usually from Asia, limiting the export value of these markets.

In Africa, ITA expects the ongoing shift towards renewable energy to continue. Hydropower should constitute a major source of new electricity capacity through 2020, particularly in Sub-Saharan Africa. Kenya, for example, is expected to develop roughly 500 MW of new hydropower-based electricity by the end of the decade. The solar PV industry should also benefit from Africa's likely renewable energy development. *Bloomberg New Energy Finance* predicts that over half of all new power systems deployed on the continent will

be small solar PV systems, which are well-suited to the regions resource potential and the lack of reliable transmission grids. The geothermal industry should also expand into Africa, with significant development expected in Kenya.

In Latin America, the deployment of renewable energy should also increase dramatically over the next six years. The region should continue to support distinct U.S. competitiveness. Although investment will very likely trail other regions, Latin America's desire to diversify its energy mix away from fossil fuels and drought-ridden large hydropower should create a thriving market for U.S. exporters. Brazil will be the largest market – in terms of both development and U.S. exports – but Mexico, Chile, and Central America should all be important export destinations.

### **Renewable Energy Technologies to 2020**

#### Solar

Solar PV has now become economically viable in many countries, and even economically preferable in some. ITA expects this trend to continue through the medium-term, although most solar projects will still require policy incentives to be competitive. By 2020, the solar experience curve strongly suggests that costs will decline enough that solar should be a viable option in markets with strong insolation rates.<sup>§</sup> U.S. exporters should seek to identify these markets and position themselves for success now, so that when development takes place, U.S. exporters are well positioned to benefit.

China is projected to be the largest solar market through 2020, followed distantly by Japan, Germany, India, and Saudi Arabia. In most of these markets, U.S. suppliers will find steep competition from other lower-cost manufacturers, but will also encounter policy barriers that restrict market access.

While net-metering restrictions could forestall growth in the distributed PV sector, in many places demand for individually-produced clean energy will be too great for policy to prevent widespread investment. The surge in distributed PV should begin to facilitate a renewed consideration of the implications for national electricity grids and, in markets with national utilities, policy changes to transmission and distribution models.

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<sup>§</sup> In some markets, solar is already viable without policy supports (e.g., Panama and Chile).

Over the medium-term, U.S. exporters are expected to also find new opportunities in the Concentrated Solar Power sector. Chile, China, Saudi Arabia, and South Africa should all develop large CSP projects, with U.S. exporters competing effectively with suppliers from other markets.

### Wind

Through the medium-term, no sector will support more renewable energy exports than wind. Manufacturing experience and economies of scale, as well as improvements in efficiencies, plant design, and operation should drive down installation costs. As costs decline, buyers may be willing to spend more on more efficient, innovative, and higher quality turbines produced in the United States. This could also result in more emphasis on design, engineering, and site assessment, which would create export opportunities for American firms.

Like the solar sector, China is also expected to dominate the wind sector for the foreseeable future. With strong resource potential, the availability of cheap technology and improving transmission infrastructure, China will install 16-18 GW of new wind capacity annually through 2020.<sup>81</sup> In fact, nearly 40 percent of the wind capacity installed through 2020 outside the United States will be in China. Capturing just a small share of this market would make China a key export destination for U.S. exporters.

The offshore wind market will very likely continue to be dominated by Northern European countries – namely, the United Kingdom and Germany – although some growth can be expected in Japan and China. While technology improvements will help reduce costs, the industry is expected to push further offshore and into deeper waters, limiting price declines as environments get more challenging.

### Hydropower

Somewhat surprisingly, the global hydropower market is projected to sustain more growth than any other renewable energy technology through 2020. Based on industry projections, ITA expects the global hydropower industry to cumulatively install over 300 GW of new

capacity outside the United States between now and the end of the decade – just less than half of all medium-term renewable energy development.

Most hydropower development will occur in the emerging markets, where the low cost of hydropower and its ability to produce baseload power (measured by levelized cost of energy) is attractive to developers, utilities, and governments. China, which has over 80 GW of capacity in its hydropower pipeline, is expected to be the largest market globally, but Brazil, Thailand, Russia, India, and Japan should all contribute to the industry's growth.

### Geothermal

The global geothermal industry will lag far behind other renewable energy sectors through 2020. The industry is expected to install just over 3 GW of new capacity outside the United States cumulatively between now and 2020. To put things in perspective, this means the world will install in six years as much geothermal capacity as China will install wind capacity every three months.

Unfortunately, geothermal is the renewable energy sector that supports the most U.S. market share. U.S. geothermal firms lead in almost every part of the industry's supply chain with the exception of turbine manufacturing, which continues to be dominated by Japanese conglomerates. Many of the Japanese firms import component parts from the United States, however, so any growth in the sector should support additional U.S. exports.

Indonesia, the country with the largest geothermal resource potential, is expected to support the most geothermal development through 2020. In fact, through the medium-term, nearly one-third of all geothermal development outside the United States should be in Indonesia. U.S. exporters are expected to capture about one-fourth of the market.

Kenya and New Zealand also should also attract significant investment, with U.S. market share expected to be even higher in these markets. Kenya plans to install 1.8 GW of new geothermal capacity by 2016 (ranking it #1 on ITA's list of top near-term geothermal

## **Figure 2: Projecting to 2020**

ITA decided to project exports through only 2020, despite the availability of industry sources that offer projections further into the future. Beyond 2020, ITA believes trade flows will be driven by primarily by renewable energy resource potential and proximity to the United States. Policy will have less of an impact because the cost of renewables will fall below that of traditional energy sources. When this happens, a country's resource potential will often determine where development is strongest.



export markets). Assuming that it falls short of this goal, it could become an important medium-term market.

**Mid-Term Rankings**

With growth expected in nearly every renewable energy market globally, ITA anticipates that Canada will remain the largest destination for U.S. renewable energy exports through the end of the decade. Most exports are projected to support Canada’s hydropower development, although Canada’s solar industry should provide an important export market, as supply chain ties on both sides of the border should deepen.

Over the medium-term, most U.S. exports will remain destined for only a few markets. The top five total markets will continue to account for over half of all exports in the sector. However, the concentrated nature of the industry’s export destinations should weaken a bit over time, as new markets attract global attention. Saudi Arabia and Thailand, for example, should account for a growing number of exports through 2020. Saudi Arabia jumps to fourth (from 10<sup>th</sup>) and Thailand moves to seventh (from 19<sup>th</sup>) in the medium-term rankings [See Figure 1].

**U.S. Export Competitiveness through 2020**

The competitiveness position of the United States’ renewable energy industry remains weak and is expected to get weaker. As a result, while renewable energy exports are projected to more than double between 2016 and 2020, the market share captured by U.S. suppliers will decline to record low levels. Policy-makers should understand which market segments support heightened competitiveness and which segments produce only investment opportunities – not a likely export sale. By knowing which markets are likely to purchase technology from the United States, and which will be predisposed to purchase technology locally or from lower cost suppliers from elsewhere, exporters can develop effective and nuanced strategies.

Through the end of the decade, the value of renewable energy exports will be split relatively evenly between wind (34 percent); hydropower (32 percent); and solar (26 percent). The geothermal industry will account for just 8 percent of U.S. exports in the sector. According to ITA’s projections, the wind industry will surpass the solar industry, as the leading exporter of U.S. renewable energy technologies through 2020. This is in line with the wind industry’s expected capacity additions globally, which will remain larger than the solar industry’s installed global capacity (solar is expected to grow faster in percentage terms).

**Figure 3: Subsector Medium-Term Rankings (2015-2020)**





## Appendix 1: Full Rankings

### Near-Term Rankings (2015-2016)

Rank	Country
1	Canada
2	Japan
3	China
4	Brazil
5	Mexico
6	Kenya
7	India
8	Chile
9	Indonesia
10	Saudi Arabia
11	Germany
12	Turkey
13	South Africa
14	Egypt
15	Uruguay
16	Ecuador
17	New Zealand
18	France
19	Thailand
20	Honduras
21	Denmark
22	Philippines
23	United Kingdom
24	El Salvador
25	Russia
26	South Korea
27	Spain
28	Sudan
29	Peru
30	Belgium
31	Nicaragua
32	Australia
33	Italy
34	Costa Rica
35	Malaysia
36	Israel
37	Colombia
38	Argentina
39	Panama
40	Morocco
41	Netherlands
42	Ethiopia
43	Venezuela
44	Guatemala
45	Tunisia
46	Iceland
47	Austria
48	Vietnam
49	Ghana

### Medium-Term Rankings (2015-2020)

Rank	Country
1	Canada
2	China
3	Japan
4	Saudi Arabia
5	Brazil
6	Mexico
7	Thailand
8	Chile
9	India
10	United Kingdom
11	Kenya
12	Germany
13	South Africa
14	Indonesia
15	Egypt
16	South Korea
17	Honduras
18	Russia
19	New Zealand
20	Uruguay
21	Turkey
22	France
23	Philippines
24	Spain
25	Italy
26	Panama
27	Belgium
28	Sudan
29	Argentina
30	Peru
31	Venezuela
32	Costa Rica
33	Nicaragua
34	Australia
35	Colombia
36	Guatemala
37	Malaysia
38	Netherlands
39	Israel
40	Ethiopia
41	Tunisia
42	Morocco
43	Vietnam
44	Mozambique
45	Algeria
46	Finland
47	Greece
48	Sweden
49	Ghana

50	<b>Hong Kong</b>	50	<b>Cote D'Ivoire</b>
51	<b>Finland</b>	51	<b>Portugal</b>
52	<b>Algeria</b>	52	<b>El Salvador</b>
53	<b>United Arab Emirates</b>	53	<b>Ecuador</b>
54	<b>Kazakhstan</b>	54	<b>Hungary</b>
55	<b>Portugal</b>	55	<b>Kazakhstan</b>
56	<b>Greece</b>	56	<b>Lithuania</b>
57	<b>Sweden</b>	57	<b>Hong Kong</b>
58	<b>Lithuania</b>	58	<b>Ukraine</b>
59	<b>Cote D'Ivoire</b>	59	<b>Austria</b>
60	<b>Slovakia</b>	60	<b>Ireland</b>
61	<b>Ukraine</b>	61	<b>Poland</b>
62	<b>Bulgaria</b>	62	<b>Romania</b>
63	<b>Ireland</b>	63	<b>Zimbabwe (Rhodesia)</b>
64	<b>Poland</b>	64	<b>Slovakia</b>
65	<b>Norway</b>	65	<b>Czech Republic</b>
66	<b>Hungary</b>	66	<b>Bulgaria</b>
67	<b>Zimbabwe (Rhodesia)</b>	67	<b>Estonia</b>
68	<b>Romania</b>	68	<b>Zambia</b>
69	<b>Estonia</b>	69	<b>Tanzania</b>
70	<b>Czech Republic</b>	70	<b>Sri Lanka (Ceylon)</b>
71	<b>Zambia</b>	71	<b>Pakistan</b>
72	<b>Tanzania</b>		
73	<b>Sri Lanka (Ceylon)</b>		
74	<b>Croatia</b>		
75	<b>Pakistan</b>		

## Appendix 2: Subsector Rankings

### Projected Wind Energy Export Markets

#### Near-Term Export Markets (2015-2016)

Rank	Country
1	Canada
2	China
3	Brazil
4	Mexico
5	Egypt
6	Uruguay
7	South Africa
8	Honduras
9	South Korea
10	Philippines
11	United Kingdom
12	Costa Rica
13	Belgium
14	Kenya
15	Chile
16	Germany
17	Netherlands
18	Panama
19	France
20	Italy
21	Tunisia
22	Thailand
23	Vietnam
24	India
25	Nicaragua
26	Guatemala
27	Japan
28	Hong Kong
29	Finland
30	Ecuador
31	Spain
32	Indonesia
33	Argentina
34	Russia
35	Lithuania
36	Morocco
37	Portugal
38	Australia
39	Ukraine
40	Israel

#### Medium-Term Export Markets (2015-2020)

Rank	Country
1	China
2	Canada
3	Brazil
4	Mexico
5	Egypt
6	South Korea
7	Uruguay
8	Honduras
9	South Africa
10	Belgium
11	United Kingdom
12	Panama
13	France
14	Costa Rica
15	Chile
16	Philippines
17	Netherlands
18	Germany
19	Kenya
20	Italy
21	Japan
22	India
23	Thailand
24	Guatemala
25	Tunisia
26	Nicaragua
27	Finland
28	Vietnam
29	Indonesia
30	Spain
31	Ecuador
32	Hungary
33	Argentina
34	Lithuania
35	Morocco
36	Hong Kong
37	Peru
38	Australia
39	Russia
40	Portugal

## Projected Solar Energy Export Markets

### Near-Term Export Markets (2015-2016)

Rank	Country
1	Japan
2	India
3	Saudi Arabia
4	Chile
5	Canada
6	Germany
7	China
8	Ecuador
9	France
10	Denmark
11	Mexico
12	Turkey
13	Thailand
14	Russia
15	United Kingdom
16	El Salvador
17	Australia
18	Israel
19	Italy
20	Belgium
21	Brazil
22	South Africa
23	Morocco
24	Nicaragua
25	Netherlands
26	Argentina
27	Panama
28	Algeria
29	Peru
30	Ghana
31	Austria
32	Malaysia
33	Greece
34	Kazakhstan
35	Slovakia
36	Philippines
37	South Korea
38	Bulgaria
39	Spain
40	Ukraine

### Medium-Term Export Markets (2015-2020)

Rank	Country
1	Japan
2	Saudi Arabia
3	China
4	India
5	Germany
6	Chile
7	France
8	Thailand
9	Canada
10	United Kingdom
11	Mexico
12	Russia
13	Australia
14	Italy
15	Israel
16	Peru
17	Nicaragua
18	Spain
19	South Africa
20	Brazil
21	Tunisia
22	Morocco
23	Algeria
24	Greece
25	Argentina
26	El Salvador
27	Panama
28	Ghana
29	Malaysia
30	Philippines
31	Austria
32	Portugal
33	Kazakhstan
34	Finland
35	Indonesia
36	Ukraine
37	Sweden
38	Poland
39	South Korea
40	Czech Republic

## Projected Hydropower Export Markets

### Near-Term Export Markets (2015-2016)

Rank	Country
1	Canada
2	Chile
3	South Africa
4	Sudan
5	Spain
6	Thailand
7	Mexico
8	India
9	Malaysia
10	Colombia
11	El Salvador
12	Argentina
13	Venezuela
14	Honduras
15	Russia
16	Morocco
17	Peru
18	Guatemala
19	China
20	Panama
21	Brazil
22	Turkey
23	United Kingdom
24	Austria
25	Costa Rica
26	Italy
27	Philippines
28	Ghana
29	Tunisia
30	Egypt
31	Kenya
32	Cote D'Ivoire
33	Sweden
34	Indonesia
35	South Korea
36	France
37	Japan
38	Ethiopia
39	Kazakhstan
40	Zimbabwe (Rhodesia)

### Medium-Term Export Markets (2015-2020)

Rank	Country
1	Canada
2	Thailand
3	United Kingdom
4	Chile
5	Mexico
6	South Africa
7	Spain
8	India
9	Russia
10	Sudan
11	Venezuela
12	Argentina
13	Japan
14	Italy
15	China
16	Colombia
17	Philippines
18	Panama
19	Turkey
20	Honduras
21	Malaysia
22	South Korea
23	Peru
24	Egypt
25	Mozambique
26	Guatemala
27	Costa Rica
28	Ethiopia
29	Kenya
30	Morocco
31	Sweden
32	Indonesia
33	Cote D'Ivoire
34	Tunisia
35	Ghana
36	Kazakhstan
37	Zimbabwe (Rhodesia)
38	Slovakia
39	Israel
40	Ukraine

## Projected Geothermal Export Markets

Near-Term Export Markets (2015-2016)	
Rank	Country
1	Kenya
2	Indonesia
3	New Zealand
4	Turkey
5	Mexico
6	Chile
7	Peru
8	Philippines
9	Nicaragua
10	Japan
11	Ethiopia
12	Iceland
13	Costa Rica
14	United Arab Emirates
15	Guatemala
16	Italy
17	Portugal
18	Germany
19	China
20	Russia
21	France

Medium-Term Export Markets (2015-2020)	
Rank	Country
1	Kenya
2	Indonesia
3	New Zealand
4	Turkey
5	Chile
6	Philippines
7	Mexico
8	Nicaragua
9	Peru
10	Japan
11	Ethiopia
12	Guatemala
13	Vietnam
14	Canada
15	Costa Rica
16	Italy
17	Germany
18	Portugal
19	France
20	Greece
21	Russia
22	India
23	China
24	Hungary

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