Disruptive technologies: Strategies for identifying emerging market opportunities

A case study in solar energy

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In an increasingly interconnected commercial landscape, business leaders must carefully consider the technological, political, economic, and competitive market variances across different markets in order to target ones that offer lasting growth. This undertaking should not be oversimplified: it is complex, time consuming, and requires deep industry and market knowledge. Launching disruptive technologies in emerging markets further complicates this task, since many experience rapid growth and/or other local dynamic factors, making strategic planning even more critical.

In the following paper, we examine solar energy, a technology that is disrupting the traditional energy industry, to demonstrate how to identify opportunities in emerging markets and develop tailored go-to-market strategies.

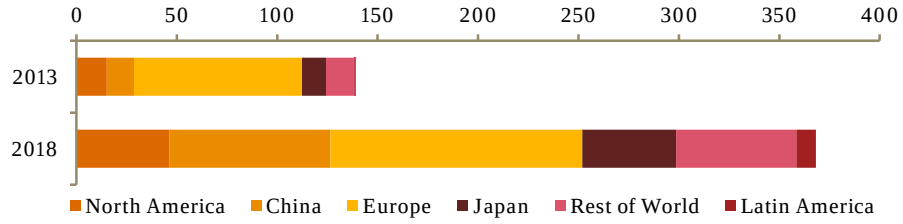
Rapid growth and emergence of new markets

When evaluating whether to enter a new geographic territory, important factors for consideration include market size, economic and other trends, competitive factors, product, labor, operating and go-to-market costs, political dynamics, and regulatory regimes in the target country.

Solar energy is an excellent example of an industry that has experienced significant growth as a result of lower costs (specifically, module costs) and favorable economic and regulatory conditions. Such growth is expected to continue, with global annual photovoltaic (PV) installations projected to increase at a 20% CAGR between 2013 and 2018[1], from a capacity of 38 GW to 100 GW.

As seen in Figure 1, European countries have been global leaders in solar deployment over the past decade, while other regions are increasingly becoming the primary drivers of growth. In particular, China and Japan are poised for impressive gains. Electricity generation from solar PV in China is expected to grow at a 42% CAGR from 2013 to 2018; China's share of global solar generation is expected to increase from 10% to 22% over that period[2]. Japan's solar generation is expected to grow at a CAGR of 31% during that same period, increasing its share of global solar generation from 9% to 13%.[3] Growth in Japan is driven by favorable market conditions such as low interest rates, high electricity prices, and increased renewables demand following its nuclear shutdown.

Figure 1. Global solar PV electricity generation (TWh)



Source: IEA 2013

Another emerging market that offers significant opportunities is Latin America, which is expected to grow at a 94% CAGR from 2013 – 2018, at which point the

[1] "Solar PV Industry Targets 100 GW Annual Deployment in 2018, According to NPD Solarbuzz." NPD Solarbuzz. N.p., 20 Mar. 2014. Web

[2] Based on IEA data from the *Medium-Term Renewable Energy Market Report 2013* © OECD/IEA 2014, IEA Publishing; modified by PwC. License: http://www.iea.org/t&c/termsandconditions/

[3] Ibid.

region will account for 3% of global solar generation[4]. Latin America is expected to install over 700 MW of solar in 2014, and some analysts predict a pace of growth that will rival that of the US five years ago[5].

North America is projected to expand at a 25% CAGR from 2013 to 2018, increasing its share of global generation from 11% in 2013 to 13% in 2018[6]. The rest of the world is also expected to experience significant growth with a 34% CAGR over the same period, increasing from 10% global share today to 16% in 2018[7]. Key markets in this segment include India, Australia, and South Africa with 4%, 4%, and 1% of 2018 global solar generation respectively[8].

This robust, sustained growth in solar is driven by considerable tailwinds. A number of factors are increasing solar's relative competitiveness as an energy source and supportive government policies are fostering growth opportunities for companies. However, these competitive drivers and policies vary significantly by market and must be well understood in order to optimally plan for success.

Factors driving competitiveness

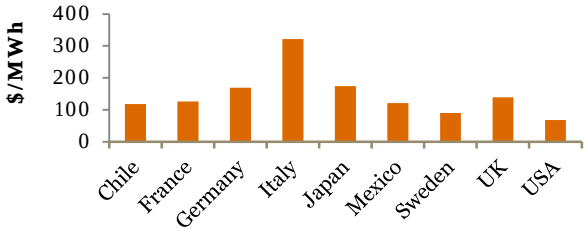
As previously mentioned, product and labor costs are a significant factor in deciding if and when to enter a new market. For the solar industry, unprecedented reductions in PV costs have helped make solar more competitive and an increasingly relevant source of energy, irrespective of the incentives provided. While these drivers exist on a global scale, there are regional disparities that must be understood.

Price of competitive technologies

Energy costs have a significant impact on the operations of many organizations. However, when looking at the solar industry, the price of conventional electricity is also a factor to consider as a competitive technology.

As seen in Figure 2, electricity prices exhibit significant variance across countries; this provides an additional driver for solar adoption in high priced markets. For example, average retail industrial electricity prices across Italy in 2013 were as high as $322/MWh, almost five times the price in the US, where taxes are relatively lower and the availability of cheap natural gas has driven the price of electricity down[9]. Electricity prices also vary significantly across customer types. For example, in Mexico in 2013, commercial electricity

Figure 2. Industrial retail electricity prices, 2013



Source: IEA 2014

[4] Ibid.
[5] "The Budding Latin America Solar Market: 5 Key Takeaways." Greentech Media., 24 Jan. 2014. Web.
[6] Based on IEA data from the *Medium-Term Renewable Energy Market Report 2013* © OECD/IEA 2014, IEA Publishing; modified by PwC. License: http://www.iea.org/t&c/termsandconditions/
[7] Ibid
[8] Ibid.
[9] Based on IEA data from the *Key World Energy Statistics 2014* © OECD/IEA 2014, IEA Publishing; modified by PwC. License: http://www.iea.org/t&c/termsandconditions/

prices were $260/MWh, while residential prices were $110/MWh for low power users and over double that rate for high power users[10]. Such variances create opportunities to hone in on specific customer segments within target countries where solar is competitive.

Cheaper and more accessible financing

Innovative financing is yet another factor that opens up markets. For the solar industry, new public and private financing vehicles are lowering the cost of capital, providing better access to capital markets, and expanding the number and type of projects that are considered attractive to the investment community. In fact, due to improved risk assessment, diversification of assets, and increased asset liquidity, the cost of capital has the potential to be reduced by 8% - 16%[11].

Markets with more mature solar and financial services industries are seeing a wider variety of institutional, tax equity, and commercial investors due to their greater appreciation of the dependable long-term cash flows from solar projects. Improved risk assessment, standardization, and new vehicles are emerging such as public solar ownership funds ("YieldCos"), solar asset-backed securities (ABS), and project bonds. To date, five YieldCos have launched globally and an additional five are likely to file by the end of 2015. Similarly, growth is expected in the bond market: Bloomberg New Energy Finance estimates that the volume of green bonds issued in 2014 could exceed $40B, which is triple the $14B issued in 2013[12]. In addition, crowdfunding is gaining traction, filling financing voids in the United States, Europe, and elsewhere. Nevertheless, despite these financing innovations, renewable energy projects in many markets (especially emerging countries) still rely on development banks and commercial banks as a major source of funding.

Complementary technologies and business models

Disruptive technologies and unique business models are impacting industries and organizations like never before. Engineers from Silicon Valley to India work around the clock to develop the latest and greatest, trying to leapfrog competitors and create new market opportunities.

The story is no different for the solar industry: complementary technologies and innovative business models are creating new applications and consumption approaches. The emergence of customer-focused business and financing models for rooftop solar creates a platform for complementary residential and commercial ("behind the meter") energy services such as energy storage and energy management systems. In addition, the low carbon, predictable, and flexible characteristics of solar PV make it a promising complement to the electrification of vehicles. By coordinating electric vehicle (EV) charging with solar output, the demand for peak power can be better managed. Not only do EV systems have the potential to store excess solar power produced during the day and supply the high demand evening hours, but EVs advantageously could charge at night when electricity is cheap and supply the mid-morning peak. Given the number of plug-in hybrid and electric vehicles deployed globally is expected to grow at a CAGR of 60% through 2020[13], the potential impact that EV

[10] "Mexico: North America's New Frontier for Solar Power." Solar Industry Mag., Mar. 2014. Web.

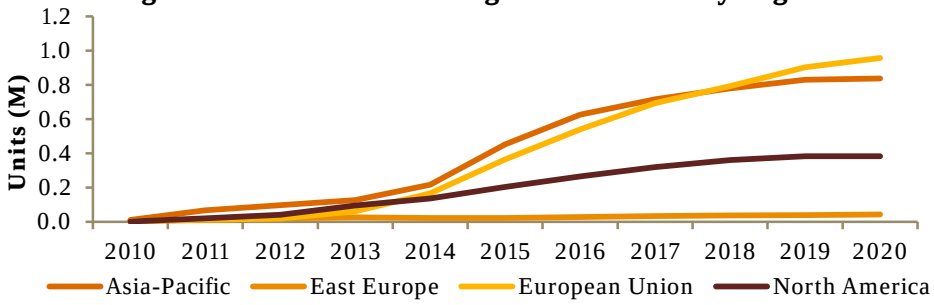
[11] Mendelsohn, Michael, and David Feldman. Financing U.S. Renewable Energy Projects Through Public Capital Vehicles: Qualitative and Quantitative Benefits (n.d.) NREL. Web.

[12] Bloomberg New Energy Finance. *Green Bonds Market Outlook 2014*. Rep., June 2014. Web.

[13] PwC 2014 Q1 Autofacts Database, PwC, 2014

adoption will have on the solar industry, particularly in Europe and Asia (see Figure 3), should be incorporated into any analysis of emerging markets.

Figure 3. Electric vehicle global volume by region



Source: PwC Autofacts Q1 2014

Balance of System: All the components of a solar system except the solar module, including inverters, racking, cables, wires, switches, and other installation elements.

Decrease in market specific 'soft' costs in addition to 'hard' costs

A broad array of costs should be accounted for when determining profitability, whether for a product line or an entire company. Some of these costs may be obvious, yet others may not be; however, incorporating all costs into an organization's financial model is critical for gaining a thorough understanding of a company's viability.

In the solar industry, installed costs have fallen dramatically since 2008, following global hardware cost decreases; this has enabled solar to become more price competitive in many markets. Future cost reductions are expected to come from sources other than PV modules, particularly those which are region specific, such as operational efficiencies, cheaper and faster permitting processes, less expensive installation labor, better procurement processes, and reduced **balance of system** costs.

The regional nature of the industry's cost structure is evident in a number of examples. In the emerging Latin American solar market, labor costs may be relatively low compared to labor costs in the United States and Europe, but remote sites and the lack of adequately trained labor may result in a higher all-in installed cost. On the other hand, US permitting costs for residential solar in 2012 were more than eight times higher than in Germany[14], a trend that continues today. However, recent initiatives such as California's AB2188 could reduce these costs by up to $0.15 – 0.20/watt by streamlining the permitting and inspection processes for residential solar installations[15].

Global efforts to address resource scarcity

Climate change, resource scarcity, and sustainability have been among items top of mind for environmentalists for decades, yet it is only more recently that they have been on the radar of businesses and governments worldwide.

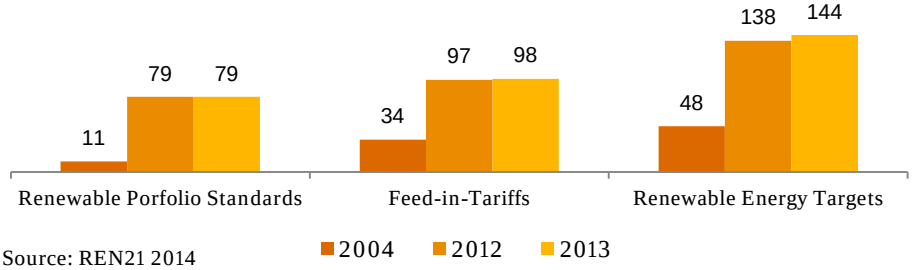
With the global population expected to reach 8.3 billion by 2030, the demand for energy is going to expand exponentially in the coming years. Industry experts

[14] "Germany vs US Installed Cost." Solar Business Focus. N.p., Sept. 2012. Web

[15] "New California Law Cuts Solar-Permitting Red Tape." Greentech Media. , 23 Sept. 2014. Web.

estimate the world will require 50% more energy than what is available today[16]; the question is how this demand will be met.

Figure 4. Number of countries with renewable energy support mechanisms



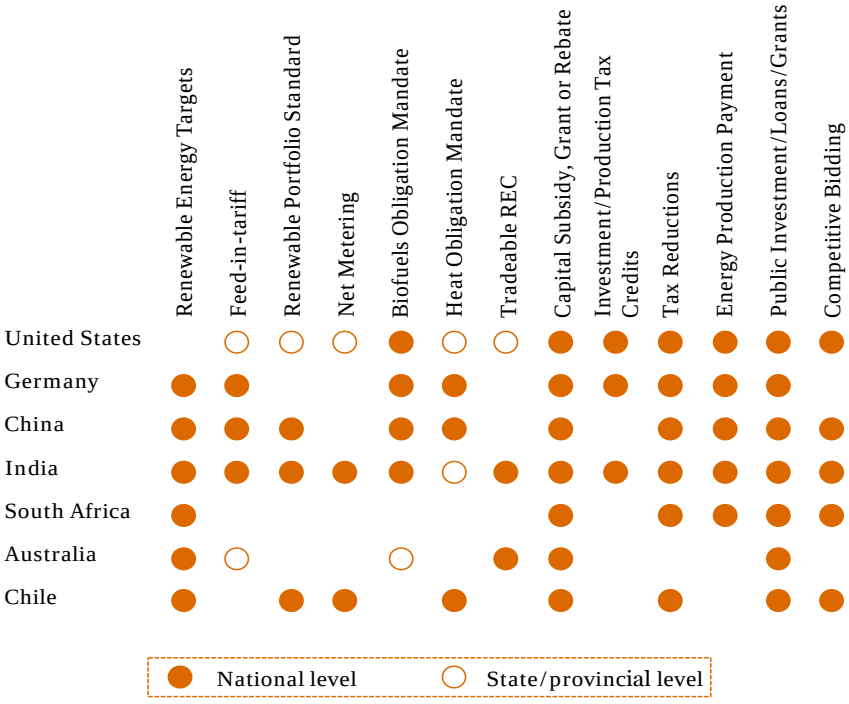
Source: REN21 2014

Renewable Portfolio Standard: A regulatory mandate that targets a percentage of electricity demand to be met by renewable sources.

Feed-in-Tariff: A policy that sets a fixed, guaranteed price over a stated fixed-term period when renewable power can be sold and fed into the electricity network, and usually guarantees grid access to renewable energy generators.

Governments recognize this challenge and have turned to renewable energy as a possible solution. As shown in Figure 4, at the end of 2013, 144 countries had set renewable energy targets to support renewable power adoption[17]. Most policies to support renewable energy target the power sector, with **renewable portfolio standards** and **feed-in-tariffs** used most frequently. However, a wide variety of policies and incentives exist in different regions, as seen in Figure 5, each of which uniquely impacts the market opportunity in each region.

Figure 5. Renewable energy policies for select countries



Source: REN21 2013

As companies seek to enter and grow market share in emerging markets, it is critical to understand how such policies create opportunities or barriers to entry.

[16] National Intelligence Council. *Global Trends 2030 Alternative Worlds.* Rep., 2013. Web.
[17] REN21. *Renewables 2014 Global Status Report.* Rep., 2014. Web.

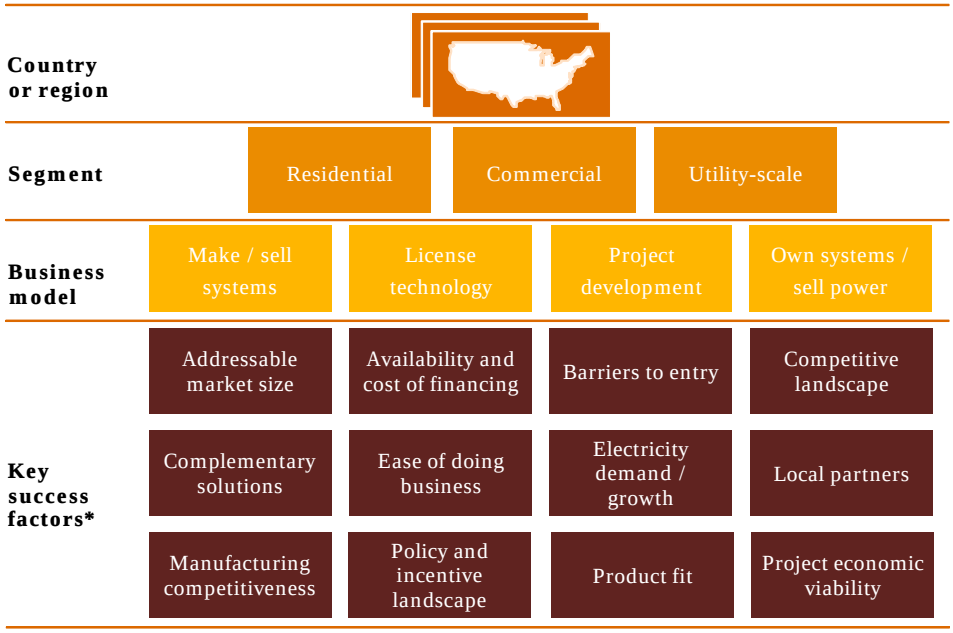
For example, net metering regulations in Mexico allow solar users to sell excess power back to the central utility; in addition, fast-track approval processes exist for projects less than 500 kW[18]. These supportive policies, in addition to high electricity rates, create opportunities to provide electricity for the residential or light commercial segment at a more competitive price than a central utility. On the other end of the spectrum, countries such as South Africa and Brazil commonly use national tenders which cater more to large utility-scale project developers.

These policy-driven mandates have provided a catalyst for further commoditization of the renewable industry, making solar more economical when compared to its non-renewable competitors in many markets. As is typical for emerging technologies, supportive policies and incentives are curtailed over time as costs for rapidly advancing clean technology decrease; therefore, having a solid understanding of the windows of opportunity can be critical to timing a successful market entry strategy.

Developing a go-to-market strategy

When evaluating growth opportunities for clients across geographies, PwC believes one size does not fit all. We use a thorough go-to-market screening and assessment methodology to help our clients succeed from initial market entry through long-run operations. One example of key considerations incorporated into a go-to-market strategy and analysis is shown in Figure 6.

Figure 6. PwC solar go-to-market considerations



* These are examples and do not represent a comprehensive list of all key success factors

Again, using solar as a case in point, we look at the industry on a macro level. This involves studying key success factors such as a country's renewable energy

[18] "The Budding Latin America Solar Market: 5 Key Takeaways." Greentech Media., 24 Jan. 2014. Web.

incentives and policies, electricity prices, and economic and electricity growth rates in order to determine market accessibility and where to play. More general business hurdles involved in going overseas must also be overcome; some of these involve tax structuring and the ability to bring investment returns out of the target market.

Solar industry-specific issues that further guide the optimal operating model include calculating project economics based on solar irradiation, installed costs, cost of financing, trade duties, and tariffs. The impact that globalization has on the solar industry must also be taken into account, as it is mitigating some of the disparities that have historically affected the cost to produce solar energy. For instance, in many regions, it is cheaper to import modules rather than establish local manufacturing capabilities; in other geographies, the reverse is true.

Additional industry-specific dynamics should also be considered, including the competitive landscape, access to local partners/knowledge, and complementary solutions. As a simple example, the strategy of pursuing smaller distributed solar projects that works well for a traditional crystalline-silicon photovoltaic company may not work for a concentrating solar company that needs scale for its plants to manage heat efficiently. Alternatively, a large company that is part of an industrial conglomerate or backed by a major energy company may be better suited than a smaller, regionally focused player to capture opportunities in markets like Saudi Arabia and other countries that welcome large consortium-based projects.

Figure 7 illustrates that different factors are impacting growth to varying degrees across select market segments. However, when all factors are considered together, each segment has the potential to be attractive as long as a tailored strategy is developed to play to its strengths.

Figure 7. Select go-to-market growth factors in sample markets and segments

Country	United States	Australia	Chile
Segment	Commercial & industrial	Large utility-scale	Commercial & industrial
Electricity demand growth	◑	◕	●
Policy support	◕	?	◔
Project economic viability	◕	◕	◕
PV production cost	◕	◕	◕
Solar radiation	◕	◕	●
Financial incentives	◕	◔	◔
Cost of financing	●	◕	◑
Competing electricity prices	◑	◑	◕
Siting/land availability	◕	●	◕
Competitive landscape	◕	●	◑
Manufacturing potential	●	◕	◕

● Very high relative attractiveness ◕ High relative attractiveness ◑ Medium relative attractiveness ◔ Low relative attractiveness ? Uncertainty

Take Chile as an example, a country where electricity demand is expected to grow 5.9% annually from 2012 through 2020[19]. Much of this demand will come from the mining industry in the northern part of the nation, which exhibits some of the highest solar irradiation in the world. These factors, combined with high and volatile electricity prices, create an opportunity to target mining companies with large-scale solar projects and remain competitive relative to conventional electricity prices, despite minimal financial incentives. However, in order to reach profitability, developers must plan operations that reduce installation labor, maintenance, and logistics costs when developing projects in remote areas.

On the other hand, while the US has seen 91% annual growth of large-scale solar installations from 2009 – 2013[20], these installations have largely been driven by highly competitive procurements to meet renewable portfolio standards as well as the 30% investment tax credit, which will decrease to 10% in 2017**.** In addition, wholesale electricity prices are relatively low due to the availability of natural gas, creating little opportunity for nascent solar players to profitably sell large-scale solar projects. However, players could target commercial and industrial customers who pay electricity rates averaging $135/MWh in California[21]. This strategy would allow players to take advantage of the increasing availability of financing, decreasing installed costs, and growing adoption of complementary technologies such as energy storage in commercial buildings. It would also be important for developers to target regions with high solar irradiation, favorable local incentives, and manageable competition.

Looking at still another market with a very different playing field, Australia has not witnessed significant utility-scale solar deployments to date due to low energy prices from alternate sources of generation and no financial incentives offered for solar. However, steady expected energy consumption growth rates of 1.4% annually through 2024[22], high solar irradiation levels, low competition from other solar players, and historically ambitious government renewable energy targets should create an opportunity to develop large utility-scale projects. Plus, solar players could maintain competitiveness by taking advantage of decreasing hardware costs and ample land availability. However, market entry timing and investment opportunity is critically dependent on the potential impact of policy. Political division is creating uncertainty around the country's Renewable Energy Target scheme which, if scaled back, could significantly reduce the short-term market opportunity.

[19] © OECD/IEA 2012 *Oil and Gas Emergency Policy - Chile 2012 Update*, IEA Publishing. License: http://www.iea.org/t&c/termsandconditions

[20] SEIA. "Solar Market Insight Report 2013 Year in Review." SEIA, 2014. Web.

[21] EIA. *Electric Power Monthly with Data for March 2014*. Rep., 2014. Web.

[22] Australian Energy Market Operator. *2013 National Electricity Forecasting Report.* Rep., June. 2013. Web.

Summary

The growth rate of disruptive technologies is driven by a number of factors, each of which impact potential target markets in unique ways. Prices of competitive technologies and complementary technologies, financing opportunities, public policy support, market size, and innovative business models are just a few of the considerations that must be taken into account when identifying new market opportunities.

To optimally plan for success, companies must consider a number of macro and industry-specific factors, some of which are moving targets. A thorough assessment of the interplay of these factors provides insight into the greatest market opportunities and a basis for a tailored go-to-market strategy and roadmap for execution.

PwC's strategy advisors

PwC's Cleantech practice leverages its extensive industry experience across the value chain to help companies solve complex business challenges. Our 1000+ Cleantech professionals worldwide have the ability to deliver lasting value to clients by drawing heavily upon the following:

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- Deep relationships with power and disruptive technology providers, utilities, financial services institutions, engineering and construction service providers, project developers, and other industry players
- Suite of offerings from strategy through execution
- Extensive knowledge across strategy, operations, transactions, tax, and assurance

With subject matter professionals across the globe, PwC's network combines local market experience with industry-specific knowledge to provide our clients with effective go-to-market strategies, approaches, and implementations. We help clients navigate the ever-changing policy landscape, overcome operational challenges, and develop sound operating models from early growth through maturity in a wide variety of industries, including solar energy.

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