THE EVOLVING LANDSCAPE FOR EPCS IN US RENEWABLES

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CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

EXECUTIVE SUMMARY

Firms that provide engineering, procurement, and construction (EPC) services play a significant role in the US renewable energy industry. This report, commissioned by and with input from CohnReznick, analyzes significant themes and trends in the industry, EPC economics for solar and wind, market size projections of EPC services for these technologies, and the experience and strategies of more than 50 EPC players.

TRENDS AND THEMES

- EPC costs are mostly falling - though this trend may not continue in coming years. Prices have been pushed up in oil & gas regions as competition for resources grows. In addition, rising commodity prices and poorer site conditions lead to higher costs, all else equal. Margins are tightening, at 5-8% for both solar and wind (though some firms will work for less). Wind margins may rise in 2015, when EPCs will be in high demand to get projects completed.
- Most developers are hungry for EPCs to assume as much risk as possible. But some experienced developers are willing to eschew 'full wraps' as a way of keeping down costs.
- Some EPCs that were general contractors with conventional energy experience have become specialists with deep expertise on renewables. Additionally, for some EPCs, the role has expanded beyond pure EPC work and into areas such as development support.
- EPCs may provide financing, but rates are usually not competitive with banks. A variation on outright financing is alternative payment structures (eg, delayed payments to the EPC).
- Some EPCs that have historically feasted on wind have now also turned to solar. Some have expressed interest in diversifying into other regions or into new technologies, like storage.
- Policy is a source of anxiety (eg, tariffs on Chinese goods, uncertainty around tax credits).
- Scarcity of engineering talent is a long-term worry.

ECONOMICS AND MARKET SIZE

- Estimated EPC *prices* (including component costs but excluding development costs) for solar PV projects range from $1.38/W for very large desert-based thin-film projects to $1.97/W for 1-5MW projects in New Jersey. Labor is the most important variable cost.
- Estimated EPC *costs* (including BOP, excluding turbines) for wind range from $0.41/W in Oklahoma to $0.62/W in New England. We used two approaches for this analysis: market interviews and examination of cost data from the now-expired 1603 Treasury grant program.
- The market size for EPC services for utility-scale PV will peak at $3.3bn in 2016 but will fall well below this level thereafter. For wind, it will be $4.8bn in 2015, and around $2bn annually through the rest of the decade. EPC for small-scale PV will fare better, at $6.3bn by 2016.

PLAYERS

- We examined the project-by-project track record of 56 firms in US renewable energy EPC. The top firms in terms of 'active' capacity are SunPower, First Solar, Mortenson, and E Light Wind and Solar (for solar) and Mortenson, IEA, RES Americas, and Blattner (for wind).

  Sources of differentiation for EPCs include: size (and bonding capacity), breadth of services, project size, and geographic focus. They also have varying strengths (track record, corporate credibility, client service) and varying approaches to business development (partnerships, in-house channels). We elaborate on each and map players to these differentiation areas.

SECTION 1. INTRODUCTION

Renewable energy capacity in the US, excluding hydropower, has more than doubled since 2008 and is set to double again by 2021. Firms that provide engineering, procurement, and construction services (EPCs) are responsible for designing and building the infrastructure of this rapidly growing market.

This report looks at the landscape of EPC services for US solar and wind. Section 2 tracks some of the key trends and themes in this market. Section 3 provides a glimpse into the economics of EPC for these technologies and provides projections for industry market size. Section 4 analyzes many of the companies involved in this market. While the report is not intended to be a primer about EPCs, an Appendix at the end provides background for readers unfamiliar with this industry and its services.

This report has been commissioned by CohnReznick – an accounting, tax, and business advisory firm that is among the largest in the US and which features a dedicated national renewable energy practice. Throughout the report, we have also incorporated insights and feedback that emerged from an EPC-focused event that Bloomberg New Energy Finance and CohnReznick hosted on September 18 in Chicago.

SECTION 2. TRENDS AND THEMES

Over the course of our interviews with market participants (both EPCs and players, such as developers and financiers, who interact with EPCs), and based on insights from our September event, the following emerged as key trends and themes in the EPC industry today:

- **Falling costs (with exceptions) and tightening margins (with upside risk)**

  The increased scale and maturity of the US solar and wind industries are, for the most part, driving total project costs down. While the cost declines have been sharpest for the capital costs of components – particularly solar modules – the EPC portion of costs has also been falling as firms that provide these services are becoming more efficient.

  There are exceptions to this trend, however. In certain regions, increased competition from the oil & gas sector for labor, logistics and commodities is pushing EPC prices higher. Regions that have felt this pinch include North and South Dakota, Texas, Oklahoma, Colorado, and parts of the Midwest, such as Illinois and Indiana. In addition, costs of raw materials fluctuate with the prices of cement, concrete, steel, metal for cabling, and other primary sources.[1] Lastly, attendees at our event noted that many of the best locations (ie, those with good renewable energy resources, flat land, and proximity to an interconnection point) have already been claimed, leaving those that will be harder and more expensive to develop.

  In terms of profit margins for the EPCs, these vary significantly by location and contract structure. But many of our interviewees agree that margins have come down since 2010 levels. Moreover, 'relative' margins are thinning – ie, EPCs are being asked to assume more risk (more on this issue below) without seeing an increase in margins to reflect this.

  EPC services for utility-scale wind have been particularly squeezed, according to some observers. Margins for this market may be in the range of 5-10%, with most falling in the lower end of this range, and it is possible that some firms are operating at lower profitability levels for some projects, potentially as low as 1.5%. (An EPC firm might be willing to accept a cut in profits if, for example, it is fostering a new relationship with a project developer.)

  For solar, the margins for competitive utility-scale projects are similar – typically 5-8% according to one interviewee (and 10% at the very best, according to another interviewee). Commercial-scale solar projects are on the higher end of the spectrum. Margins may continue to be squeezed as module prices reverse course after having fallen consistently over the last several years (module *costs* are falling, though no longer as fast as they once were, but module prices are actually increasing due to recent tariffs on Chinese goods –more on this below).

  But a continued downwards trend for margins is not inevitable. Margins are subject to supply-demand balance, and demand (the amount of new renewable energy built each year) is lumpy, increasing and decreasing with deadlines and extensions of key incentives. EPC services could be in especially high demand next year (2015) as developers rush to meet a 'soft' deadline for the Production Tax Credit (see below, under *Short-term anxieties: policy* for more on the PTC deadline). This could prompt a slight uptick in margins.

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1 For example, ready-mix concrete rose 3-4% (depending on the region) between August 2013 and August 2014, according to the Bureau of Labor Statistics' Producer Price Index. But construction materials as a whole increased at around 1.7% for that period, consistent with inflation.

- **The rap on full wraps**

  EPC contracts are designed to lay risk on the contractor, and project developers and financiers continue to ask EPCs to assume more of this risk. According to some, there is a growing requirement for 'full wrap' or 'performance wrap' contracts – ie, contracts that include all performance guarantees, workmanship warrantees, and other assurances for liabilities. Full wraps are standard for many large EPC contracts.

  Yet others dispute that this is a growing trend. At our event, various players observed that highly experienced wind developers have been willing to take on more risk rather than pay a premium for a full wrap. One representative of an EPC firm also observed that the solar industry has progressed more quickly than the wind industry did towards breaking out scopes (ie, as opposed to a full wrap) as a way to drive down costs.

- **Bigger is increasingly better**

  Banks look for EPCs to meet certain credit rating requirements. If an EPC firm cannot meet the requirement, it could compensate with other assurances such as higher *bonding capacity* – ie, security offered by a third party to cover potential damages (see Table 5 for more on this). Bonding capacity is a reflection of the cash reserves and health of the company. Typical bonding requirements are around 1% of the project costs. The market for EPC players serving the wind sector is limited by firms' abilities to provide $1-2m in bonding on a 50-100MW project. There are even fewer that have the capacity for the larger 300-400MW projects.

  Given these trends around EPCs being called upon to absorb more risk and tendencies towards higher credit or bonding capacity requirements, firms with big and sound balance sheets are best positioned. The level of guarantee that an EPC can provide is a competitive advantage over other players, and bigger and healthier firms can obtain higher bonding capacities from surety companies.

- **Expertise and extracurriculars**

  Over the last decade, key EPCs have evolved from general contractors with experience in conventional energy into specialists with deep expertise on renewable energy. This expertise can extend beyond the world of EPC and into knowledge of financing obstacles, development trends, and technology advancements.

  Similarly, the role of EPCs is expanding beyond pure EPC work (ie, 'extracurriculars'). Some EPCs are engaging earlier in the relationship with the developers; it is not uncommon for EPCs to help on certain development work such as permitting and securing the point of interconnection. RES Americas, for example, calls itself a 'services' company, whose support of a project include assistance with project development.

- **Sporadic comingling with financing**

  A few EPC firms, notably Bechtel, can provide financing to help get clients' projects over the finish line. But several firms mentioned that, while they can provide construction financing, the rates that the EPCs would offer are not competitive with construction loans offered by banks.

  A variation on outright financing is alternative payment structures – eg, offers to accept cash on completion rather than on cash on delivery. Smaller developers who have not yet secured project finance may ask their EPC firm to delay payments, especially those associated with design and engineering costs (a classic case of Catch-22: developers need to have this design and engineering in hand to secure financing, but these services themselves, which can cost around $1m, need to be financed). But most EPC firms with whom we spoke are not accepting this request of delayed payments or are reluctant to offer this. In general, arrangements for at-risk work are usually reserved for preferred clients, not for first-time customers.

There does not appear to be a trend towards more participation in financing by EPCs, and most of the investors at our event agreed that EPCs need not bring financing to the table; EPCs are measured on their ability to do their primary job – namely, to bring the project to fruition. But one tax equity investor noted that large EPCs could differentiate themselves, and help solve a problem in the industry, by providing early-stage financing. To explain, some projects seek tax equity too early in the development process, according to this investor, and having the EPC to help bring the project further along before requesting tax equity would make the financing process more efficient.

Overall, even if they are not providing financing themselves, EPC firms still figure prominently into a project's financing story. Developers can leverage a performance guarantee from a creditworthy EPC to secure bridge financing from banks. And while tax equity providers do not tend to take construction risk, and therefore tend not to worry much about the EPC, banks providing construction debt do – and will audit the EPC firm to assess its dependability.

- **Greener pastures**

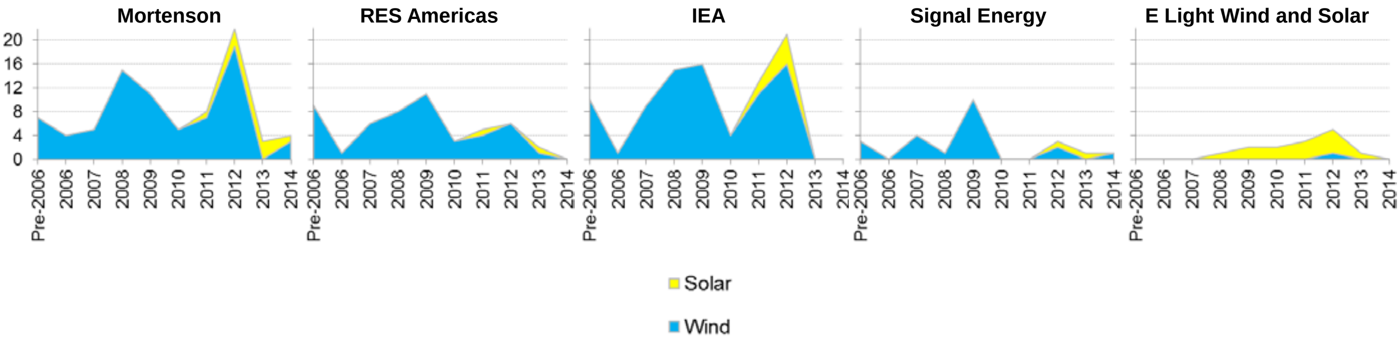
Some EPC firms that have historically feasted on wind have now also broadened their attention to solar. While wind industry peaked in 2012 and is vulnerable to start-stop policies, the solar industry has been steadily growing. By turning to solar, and especially smaller utility-scale solar projects (1-10MW) in states with robust incentive schemes, EPC firms may be able to find higher margins than what they have come to expect from wind.

Figure 1 shows this technology diversification for five EPC firms. (The chart is based on the number of projects commissioned; the extent of diversification would be much more muted if we showed the chart in terms of capacity, since wind projects tend to be larger than solar projects.)

Nevertheless, despite this diversification, firms that stick to large utility-scale projects have cause for concern come 2017. By that year, assuming status quo, federal incentives for both technologies will have run their course and dropped in value (more on this below, under *Short-term anxieties: policy*).

There is also diversification into newer technologies such as: hybrid projects involving renewables and gas; microgrids; and storage projects. (The latter in particular surfaced as a key area of interest several times at the event.) The ability to take on a first-of-a-kind project can set apart an EPC from its competitors, and allow it to gain early expertise in a sector that may be profitable in the future, even if it is not yet today.

Figure 1: Evolving focus for EPC firms active in US renewables, 2006 – 2014 year to date (number of projects by technology by commissioning year)



Source: Bloomberg New Energy Finance, company websites. Notes: See Appendix B: Methodology for analysis of EPC players.

There is also evidence of geographic diversification, in order to ensure continued business when the US market staggers or to seek out higher profitability. IEA and AMEC, for example, have developed a formal presence in Canada through subsidiaries or partnerships (these structures may have been chosen to comply with local content rules[2]). Companies such as RES Americas, First Solar, and SunPower have followed the wave of developers that have entered Chile (or have built their own development pipeline there), where high insolation and high electricity prices in the north of the country offer opportunities for utility-scale solar. Others have also expanded to Puerto Rico, which has a unique storage requirement but which has been a difficult market, and to Japan, where solar is booming.

Not all players have followed this trend, though; some have felt that foreign markets have not moved fast enough to merit strategic entry. Mexico has been a disappointment to date; it is close to home for US EPC firms but growing slowly in the eyes of some – though that may change in the coming years following important energy reforms that were recently enacted.

- **Short-term anxieties: policy**

  Solar: EPC firms active in the solar business are worried about US tariffs on Chinese and Taiwanese-sourced components.[3] The tariffs will probably result in increased equipment costs, which could increase overall project costs and potentially derail some new build; it could also result in developers putting more pressure on EPC firms to reduce their pricing in order to keep overall project costs in check.[4]

  Wind: On the wind side, there is apprehension around the most important incentive, the Production Tax Credit (PTC). As per the legislation which authorized the latest version of the PTC and the series of clarifications that have been issued by the Internal Revenue Service (IRS) over the course of 2013-14 around PTC qualification, projects have at least until the end of 2015 to be PTC-eligible (so long as they met certain initial criteria by the end of 2013). In addition, some projects will even be able to qualify in 2016 if they demonstrate that they have been in a stage of "continuous construction" – though projects that fall into that year will face increased scrutiny from the IRS and could potentially end up empty-handed.

  Generally, it is developers who have cause for concern with this issue. In their contracts with EPCs, developers have tried to include guarantees for foregone revenue in the event that the project misses the PTC deadline – but EPCs have pushed back.

  Both: Across both technologies, the expiration or reduction in value of key incentives after 2016 is a major problem for firms dedicated to large utility-scale projects. Assuming no policy changes, the PTC will effectively be finished by 2016, and the Investment Tax Credit (ITC) for solar will drop in value at the end of that year. This will leave both technologies competing with little subsidy support against existing wholesale power or against new build gas plants –

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2 Quebec's local content rules require that wind projects spend 40-60% of the project budget on regional content or be spent in the province. Also, projects must be structured as 50-50 partnerships with local communities.

3 Through a series of decisions dating back to May 2012, the US government has imposed tariffs on Chinese-sourced modules. The two most recent rulings have been a proposal by the US Department of Commerce on 2 June 2014 to impose *anti-subsidy duties* on Chinese modules (including those using non-Chinese cells) and a 25 July 2014 proposal to apply *anti-dumping tariffs* on Chinese modules and Taiwanese cells and modules. Our own view is that these latest rounds of tariffs will increase module prices but not nearly enough to threaten the growth of PV in the US.

4 These tariffs are only applicable for crystalline silicon photovoltaic (PV), which strengthens the hand of companies that do not use this technology, namely First Solar (which makes and deploys thin-film PV). Solar thermal electricity generation technologies are also not impacted by the rules, but this technology is still more costly than PV.

a frightening prospect with gas prices projected to stay low for a long time to come (below $5/MMBtu on a real basis through 2024 according to our own long-term forecasts). Distributed generation, which usually competes against retail electricity prices, has a healthier outlook.

- **Long-term anxieties: workforce**

Engineering companies are worried there will not be enough qualified engineers despite a growing demand for their skills. (According to the US Department of Education, engineering majors among total college graduates has declined nearly 40% as a percentage of total graduates in the last two decades.)

SECTION 3. ECONOMICS AND MARKET SIZE

In this section, we analyze the economics of the EPC portion of solar (specifically PV) and wind projects and the projected market size of EPC for these sectors in the US over the rest of the decade.

3.1. ECONOMICS – METHODOLOGY

The economic analysis was mostly compiled through a series of interviews with industry experts, our own data on equipment and all-in costs, and additional secondary market research published by the National Renewable Energy Laboratory (NREL) around wind costs. For the wind sector, we also used data from the now-expired cash grant program offered by the US Treasury (the '1603' program). While a bit dated (the data is from 2009-12), it offers the great advantage of transparency: projects that received grants were forced to disclose their total capex.

The outcome of this economics analysis is a breakdown of EPC prices for hypothetical projects of various sizes and locales. Special consideration is given to the fact that EPC costs vary greatly depending on plant capacity, geography and relationship with the developer. Overall, we should stress that *the figures we present here are estimates assembled from diverse sources*; EPC prices for projects is of course sensitive information, and hardly a case of one-size-fits-all.

Some cost components vary little across different projects. These types of components may include modules, inverters, turbines, transformers, and cables.[5] Other key components, however, vary greatly between projects and account for much of the disparity in EPC prices. These components are also more sensitive to qualifying factors such as geography and size. For both solar and wind, the variable component with the widest price range is labor.

Lastly, while this analysis focuses on EPC-specific economics, the total all-in costs of a project include development costs (and margins for the developer), which can vary widely. For solar projects, we have excluded development costs and margins; for wind, we have included them. The reason for this discrepancy is that there is a regional trend for wind development fees that we can identify, whereas for solar, developer margins are too project-specific, making it more difficult to come up with an aggregate number. For example, in New England, since the lead time to build a project is significantly longer than in other regions, and since developers there take a bigger risk getting the project off the ground, they expect a higher return.

3.2. ECONOMICS – SOLAR

EPC costs for solar projects vary by size and geography. A smaller commercial rooftop system, for example, and a utility-scale solar plant will have different footprint and foundation requirements, design specifications, grid connections, and other characteristics. These factors will not only affect the final price but also the scope of the EPC work.

Components with relatively constant costs, such as modules and inverters, make up the largest portion of a project's total costs. Prices are currently in the range of $0.71-0.73/W for modules and $0.11-0.13/W for inverters.[6] Together, this accounts for 40% to 50% of the total system price.

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[5] There are of course exceptions. Module costs might be slightly lower for a very large order; cabling costs will vary depending on the size and layout of the wind project; increases in turbine hub height can swing the cost of the turbine by as much as $0.5m/MW.

[6] These figures are based on our monthly Solar Spot Price Index. Importantly, module costs are expected to rise because of recent tariffs on Chinese manufacturers; we estimate the increase will be around $0.10/W.

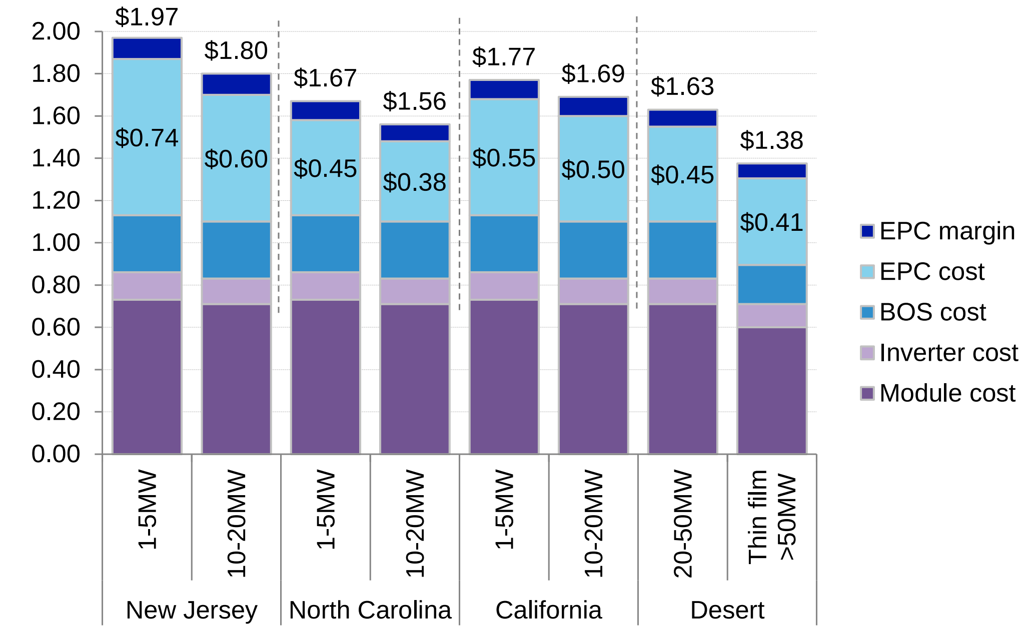
As noted earlier, a major source of price differentiation across similarly-sized projects is labor costs. Another source of price differentiation concerns property rights.

- **Labor** is dependent on the location of the project and the local labor culture. In a county with a prevalence of unionized labor, the EPC would need to hire a more expensive local workforce for part of the construction phase. Labor costs in New Jersey, for example, are estimated to be 15% higher than in other jurisdictions. Anecdotal evidence suggests that unionized labor can add $0.10-0.20/W.
- Costs also vary because of **property rights**. While buying or renting land is a development cost, the costs associated with obtaining permits for particular work might fall to the EPC. Low-density areas such as New Mexico and Nevada tend to have cheap property-related costs. Utility-scale projects larger that 20MW are rare in parts of the country with high population density, whereas projects larger than 50MW can still be found in the Southwest.

Figure 7 depicts estimated EPC prices for eight projects across four geographies: New Jersey, North Carolina, California and the Desert Southwest.

New Jersey, which has some of the highest unionization rates in the country, has an estimated EPC price of $1.97/W for a 1-5MW project and $1.80/W for a larger project (10-20MW). The difference between New Jersey rates and that of the next most expensive, California, is due to more expensive labor and land in New Jersey. The cheapest EPC costs are for projects built on desert-like properties with nearly no land costs. Permits in those regions are also easier to obtain, and since there is no local labor force (few people live in the desert), the EPC can hire a non-unionized travelling workforce.[7] Also, because there is no land constraint, it is often sensible to build solar projects using cheaper thin-film modules.[8]

Figure 2: Solar – estimated EPC costs and overall project economics for different project sizes across various US regions (excludes developer costs and margins) ($/W$_{DC}$)



Source: Bloomberg New Energy Finance, interviews with selected market participants. Notes: New Jersey

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7 In the eyes of many EPCs, an in-house travelling workforce is preferable to union labor, despite the incremental costs of travel.

8 Thin-film modules are cheaper on a per-Watt basis but also take up more space. For this reason they are not ideal for projects with space constraints like rooftops or small properties.

labor prices are higher than for other regions, due to unionized labor. Module prices derived from our July 2014 Solar Spot Price Index and inverter prices are taken from our Solar Inverter Market Update. The Desert region includes parts of southern California, Nevada, New Mexico and Arizona.

3.3. ECONOMICS – WIND

For our analysis of EPC wind economics, we assume similarly-sized projects, with roughly comparable costs for components such as turbines, controllers, collection system and other electric work (again, in practice, these vary based on factors such as turbine hub height and project layout). The key variable cost components of a wind farm are those that are dependent on the specific location of the project, such as costs associated with foundation work, labor, generator-interconnection transmission line ('gen-ties'), and civil work.

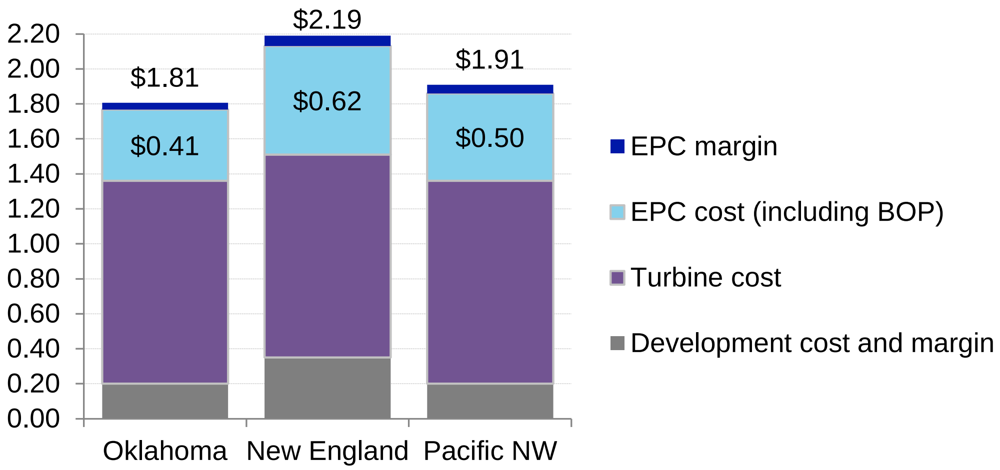
- **Foundation work:** Laying the foundation for the turbine is an important step to ensure the equipment functions at an optimal level while maintaining stable costs. Additionally, as more wind is built, we can assume that the projects will be developed on less ideal terrain and soil conditions (earlier projects pick the best locations first). The design of the foundation will be integral in balancing physical support costs. In hilly regions, such as the Pacific Northwest, foundation costs increase to compensate for the terrain. This will also impact the total turbine installation cost.
- **Labor:** An isolated wind farm might require the travelling workforce to bring certain provisions. A project located in a region with a strong labor union will require more expensive local workers.
- **Gen-tie lines:** These connect the plant to the grid and are entirely dependent on the distance to the nearest transmission lines. The costs of gen-ties increase not only with distance but also with voltage and infrastructure (eg, wooden utility poles are cheaper than metal), so it is difficult to simplify these costs to an average figure. In Figure 3, we assume projects use a one-mile-long line at a rough estimate of $1m per mile (this assumption is for a 345kV line using metal poles; we have also heard estimates of $500,000 per mile for lower-voltage lines using wooden poles).
- **Civil work**: Civil work includes a number of sub-categories but is often associated with road construction. Wind farms are generally found in isolated areas and as a result, require an access road for equipment and employees. This component is most expensive in the Pacific Northwest due to the hilly terrain and dense woods, although it can also be pricey in New England due to the complex regulatory framework for permitting roads.

We use two approaches to understand EPC economics for wind. The first approach mirrors what we did for solar – an assessment based primarily on interviews. The second approach draws on data from the Treasury cash grant program.

Approach 1 – Anecdotal data from interviews and other sources

Figure 3 depicts overall project costs for three sample 50MW wind projects in different areas of the US: Oklahoma, New England, and the Pacific Northwest. Overall, the cheapest wind EPC (around $0.41/W) can be found in the center of the country, such as in Oklahoma and Kansas. Labor costs are relatively low, land is flat, and there is a robust network of transmission lines. The Pacific Northwest is more costly at $0.50/W; the mountainous terrain leads to higher construction costs. New England is the most expensive at $0.62/W, attributable to higher permitting costs for civil work.

Figure 3: Wind – estimated EPC costs and overall project economics for a 50MW project across various US regions ($/W$_{DC}$)



Source: Bloomberg New Energy Finance; interviews with selected market participants; NREL, March 2013, 2011 Cost of Wind Energy Review. Notes: EPC price (cost plus margin) equals total project cost minus development costs (and margins) and turbine costs. Prices are representative of a 50MW wind plant with a 1-mile gen-tie. Total capex numbers are partially based on our analysis of data from the Treasury cash grant program (more on this below). Wind turbine costs come from our H2 2014 Wind Turbine Price Index. We assume EPC margins are 10% of EPC costs.

Approach 2 – Data from Treasury cash grant program

In this approach, we attempt to back out an EPC price for wind projects by looking at evidence from projects that received funding under the Treasury's cash grant program.

From 2009-12, US wind projects were eligible to elect a cash grant from the US government in place of the PTC. The US Treasury's 1603 cash grant program was a temporary measure introduced to facilitate renewable energy project development after the financial crisis by eliminating the need for project developers to rely on tax equity financing. Project owners could receive a cash payment from the Treasury equal to 30% of qualified costs, which generally correspond to total capex.

Treasury discloses award recipients and the amount they receive. We used this information to calculate the total project costs of 276 individual wind farms, representing about 22GW of total capacity. It is the largest available collection of individual project capex data for the US market.

To estimate the EPC-specific costs, we used our Wind Turbine Price Index[9] and other assumptions to remove turbine costs from the total project costs. In Figure 4 below, we compare the average EPC costs for projects in each state to the national average.

The results mostly confirm our understanding of wind EPC costs gained through interviews (Approach 1 above). Generally speaking, eastern regions, particularly New England and New York, have higher costs than the rest of the US due to the logistical and regulatory difficulties of building in that region. The central corridor is the cheapest place to build in the US, while California has slightly higher costs on average. The most expensive places to build are, understandably, Alaska and Hawaii, where the average capex was over $3.5m/MW.

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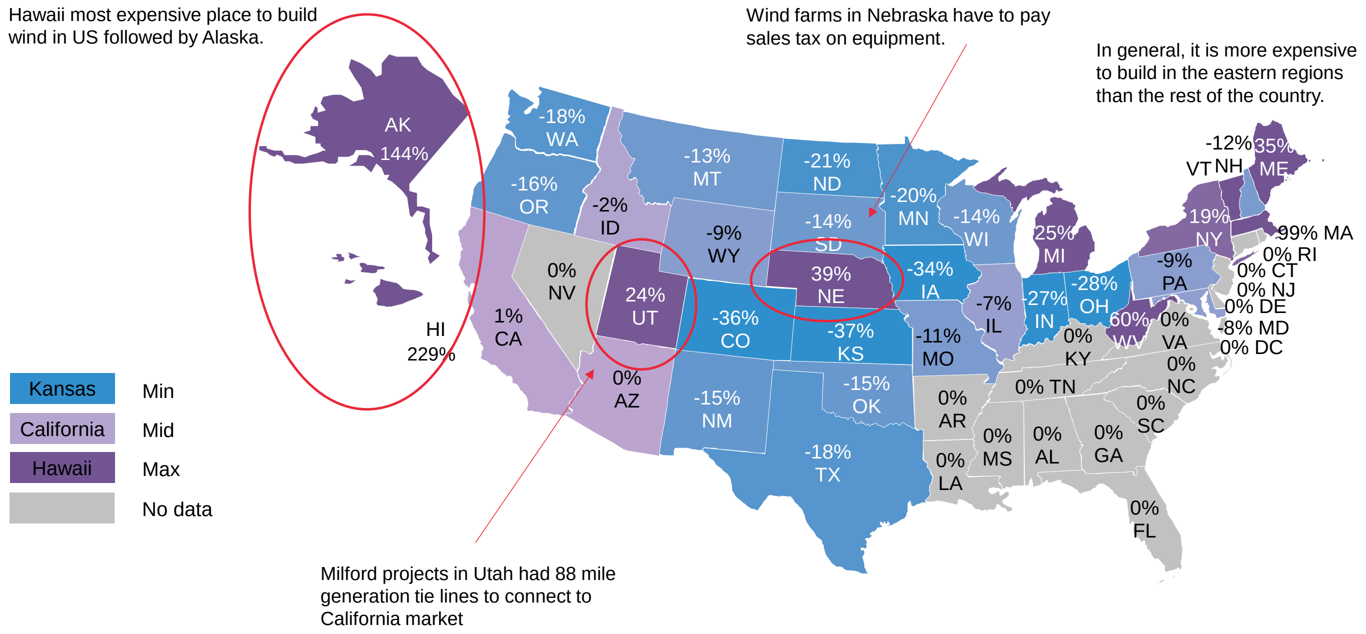
[9] The Wind Turbine Price Index is based on turbine contract data provided by 28 Index participants under non-disclosure agreements. It covers over 14GW of contracted capacity.

There were a few anomalies. Texas, which is widely considered the cheapest state for wind in the US, was not on average the cheapest of all states in the analysis. Kansas, Colorado and Iowa came in less expensive. Illinois and the Pacific Northwest, which reportedly have higher costs (Illinois due to the union labor mandates in the state, and the Pacific Northwest due to the mountainous geography) came in below average in the analysis.

Two other states stand out: Utah and Nebraska. Utah, whose average ranks near the top of all states, only had two projects included in the dataset, First Wind's Milford I and II. Those projects had an 88-mile generation tie line to connect them to the California market (which would have pushed their costs significantly higher). Nebraska has reportedly higher cost for wind than its neighbors due to a state sales tax on equipment.

Figure 4: Average estimated EPC costs by state compared to US average (% from average)



Source: Bloomberg New Energy Finance, US Treasury

3.4. MARKET SIZE

Our forecast for market size of the EPC industry for solar (PV only) and wind through 2020 is based on two inputs: projected deployments and expected EPC prices.

Methodology

We estimate market size in terms of payment flows (ie, dollars that will be paid to EPC firms). In our analysis, we exclude the costs of modules and inverters (for solar) and costs of turbines (for wind) from the total EPC market, since these components have separate (and meaningfully different) cost curves that might skew the outlook of the EPC market. As a simplification, we assume that the funds that EPCs receive are paid upon project commissioning (in reality, though, firms accrue revenues throughout the EPC process of a project). Finally, our analysis assumes the status quo for federal and state policies through 2020.

Results

In the **utility-scale solar PV** sector, the annual market size will be around $1.9bn this year and will hit a high of $3.3bn in 2016 (Figure 5). In 2017, the industry will see a sharp decline to $160m, or a 90% drop, as the federal Investment Tax Credit (ITC), which currently offers a tax credit equal to 30% of capex, will drop to 10% in 2017. As a direct result, utility-scale solar PV build will decline significantly, meaning reduced demand for EPC work.

On the **wind** side, the annual market size will reach $2.7bn this year and will rise to $4.8bn in 2015 (Figure 6). Wind installations are expected to be around 5.3GW this year, 9.7GW in 2015, and 3.6GW in 2016.

For the next three years, the PTC will drive build. Beyond 2016, the wind industry will not collapse entirely after the effective expiration of this key incentive. New demand will be buoyed by other drivers, including states' Renewable Portfolio Standards (RPS). The majority of new RPS-driven demand will come from the PJM region.

Figure 5: Projected market size for EPC services for US utility-scale solar PV by region, 2014-2020 ($bn)

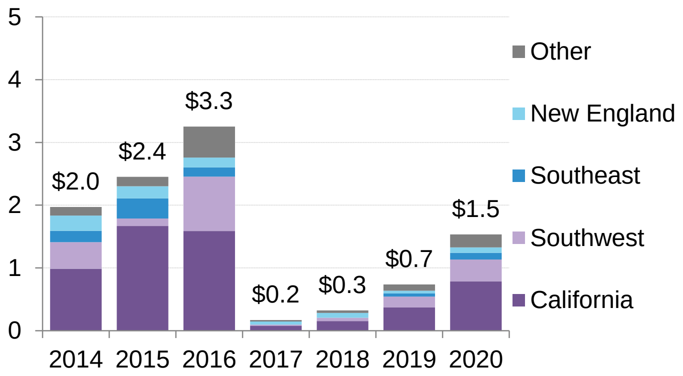
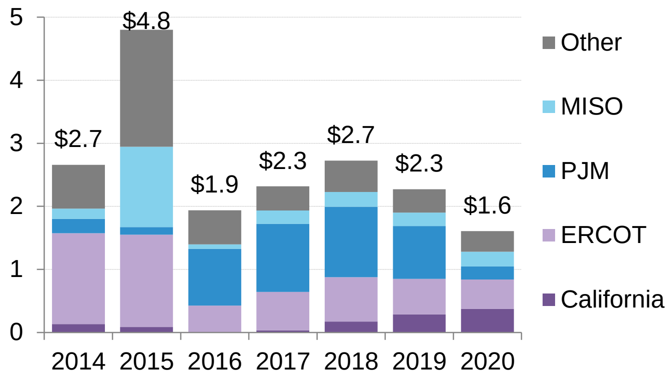


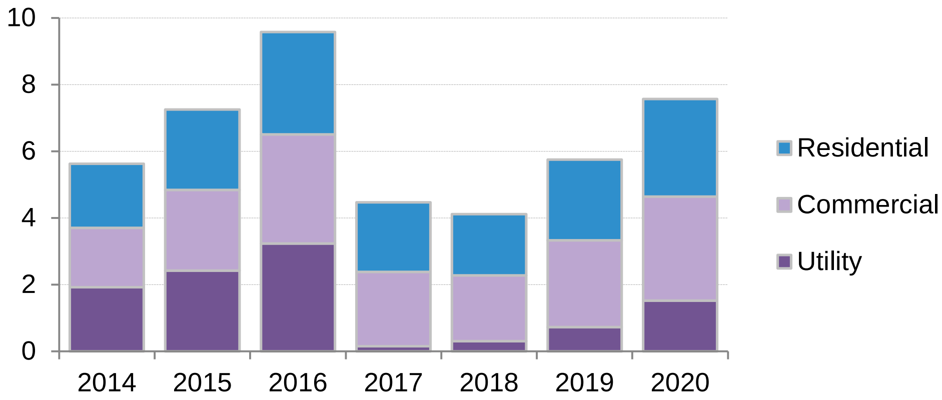
Figure 6: Projected market size for EPC services for US wind by region, 2014-2020 ($bn)



Source: Bloomberg New Energy Finance. Notes: See 'Methodology' section above. All figures are in real dollars and do not account for inflation. 'EPC services' includes the estimated cost of BOS for solar and BOP for wind, the estimated EPC costs, and the estimated EPC margins.

The **small-scale solar PV** sector, in contrast to utility-scale PV, will fare well despite the reduction of the ITC after 2016 (Figure 7). Consequently, the EPC market for small-scale (residential and commercial) will also bounce back quickly. The EPC market for small-scale PV will be around $3.7bn this year and $6.3bn by 2016. In 2017, the market will drop to $4.3bn, down from the previous year but still above this year's levels.

Figure 7: Projected market size for EPC services for US solar PV by sector, 2014-2020 ($bn)



Source: Bloomberg New Energy Finance. Notes: See 'Methodology' section above. 'Utility' refers to projects above 1MW; 'Commercial' refers to projects in the 10kW-1MW range; and 'Residential' refers to projects below 10kW.

SECTION 4. THE PLAYERS

This section of the report analyzes players in EPC for solar and wind in the US.

About this analysis

This section is based mostly on data gathered from companies' websites. Much of this analysis relies on linking firms to projects in our database, which contains nearly 3,000 wind and solar projects in the US at various stages of development. The information mapping projects to their EPCs is captured in our Industry Intelligence database, available to subscribers of our service.

There are a number of assumptions, caveats, and methodological points that are important to note in the context of this analysis; an Appendix at the end of this report identifies these.

4.1. LEAGUE TABLES

The charts below show the top EPC firms for solar and wind, ranked strictly in terms of historic activity – ie, this does not reflect any kind of qualitative assessment about firms' competencies.

- Top-ranked solar EPCs includes the three vertically-integrated giants – SunPower, First Solar, and SunEdison – and some EPC specialists, like Bechtel and Fluor, that have performed a small number of very large projects.
- The league tables for wind are headlined by Mortenson, IEA, RES Americas, and Blattner (with Blattner under-represented, as explained in the Appendix).

Figure 8: Top EPC firms for US utility-scale solar (GW of 'active' projects)

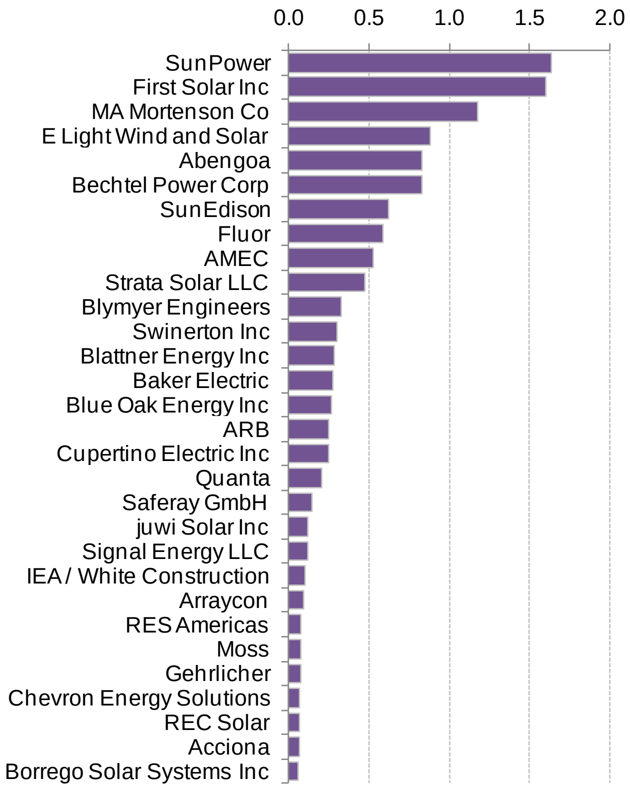
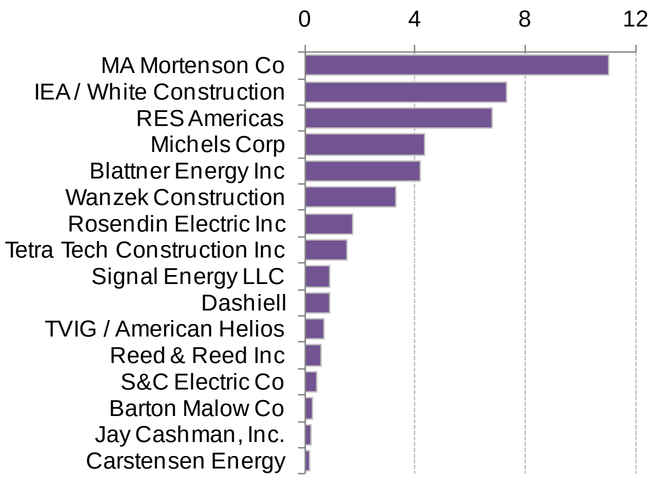


Figure 9: Top EPC firms for US wind (GW of 'active' projects)



Source: Bloomberg New Energy Finance, company websites Notes: (1) 'Active projects' refers to projects that are in development or already operational; it excludes projects that have been abandoned. (2) See Appendix B: Methodology for analysis of EPC players.

Figure 10 and Figure 11 show league tables in terms of number of projects, rather than cumulative capacity as had been shown above. The three big solar players are again among the top (Figure 10), but so are players such as Strata specializing in smaller, 'repeatable' projects. For wind, rankings for capacity (Figure 9 above) and number of projects (Figure 11 below) are similar.

Figure 10: Top EPC firms for US utility-scale solar (number of 'active' projects)

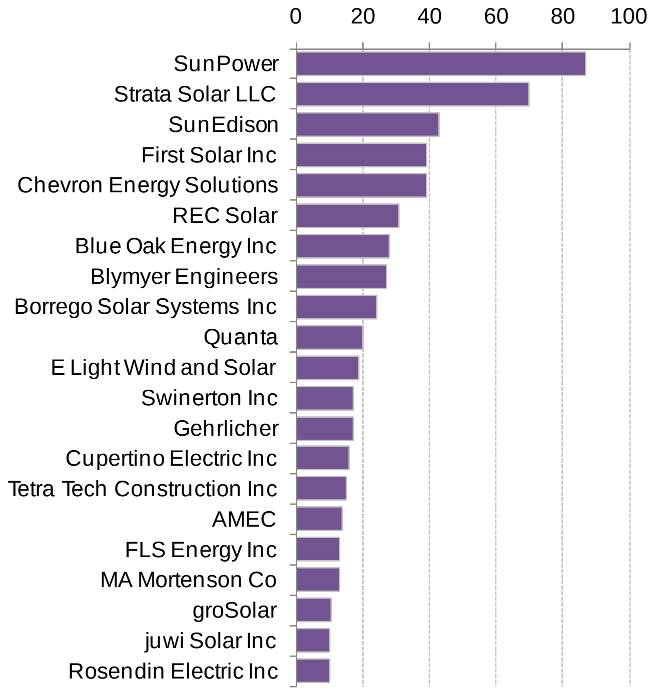
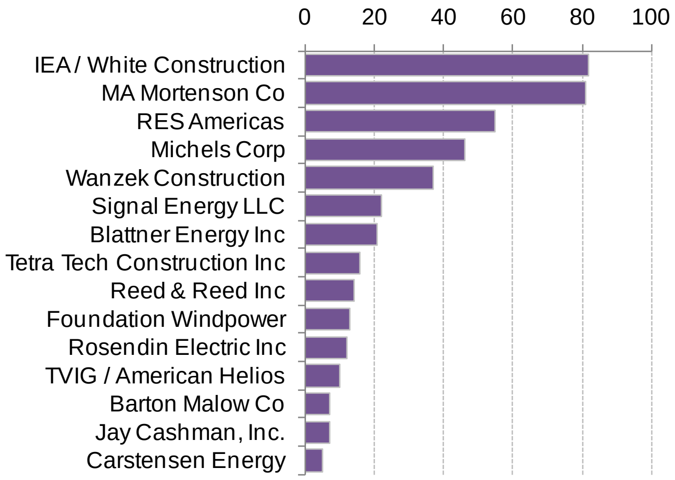


Figure 11: Top EPC firms for US wind (number of 'active' projects)



Source: Bloomberg New Energy Finance, company websites. Notes: (1) 'Active projects' refers to projects that are in development or already operational; it excludes projects that have been abandoned. (2) See Appendix B: Methodology for analysis of EPC players.

For our analysis, we have treated any project above 1MW as utility-scale – but in practice, very small utility-scale projects often tend to fit into the portfolios of EPCs that are focused on commercial-scale opportunities. Table 1 at left shows the *disclosed* commercial-scale PV activity of selected EPC firms that have extensive experience in this market.

EPC activity for commercial-scale PV is more extensive than what we have depicted in this analysis, as we have focused our attention on the utility-scale market. For example, the capacity values shown in this table are based on a bottom-up approach (we only show the sum of the projects which the companies have specifically identified on their websites), but SolarCity – not shown here, since they do not reveal project-by-project details – has installed 241MW of commercial-scale PV.

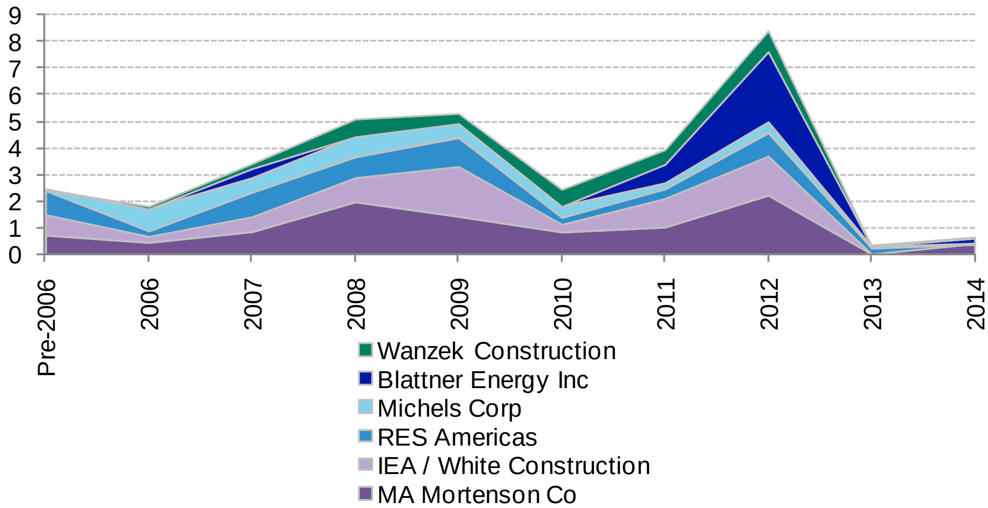
Figure 8 and Figure 9 above showed 'static' league tables – a snapshot of rankings of the biggest players based on all commissioned and in-development projects cumulatively. Figure 12 below shows year-by-year activity for the top six players in wind. The striking characteristic here is not any single player's rise and fall but rather the jaggedness of the industry results overall.

Table 1: Commercial-scale PV activity by selected EPCs

	Capacity (MW)
REC Solar	29.3
Borrego	10.4
RGS Energy	6.5
Blue Oak	6.5
Baker Electric	6.0
Quanta	6.0
groSolar	5.0
Cupertino Electric	4.9

Source: Company websites. Notes: (1) 'Capacity' is sum of disclosed projects on website. (2) RGS was Real Goods Solar.

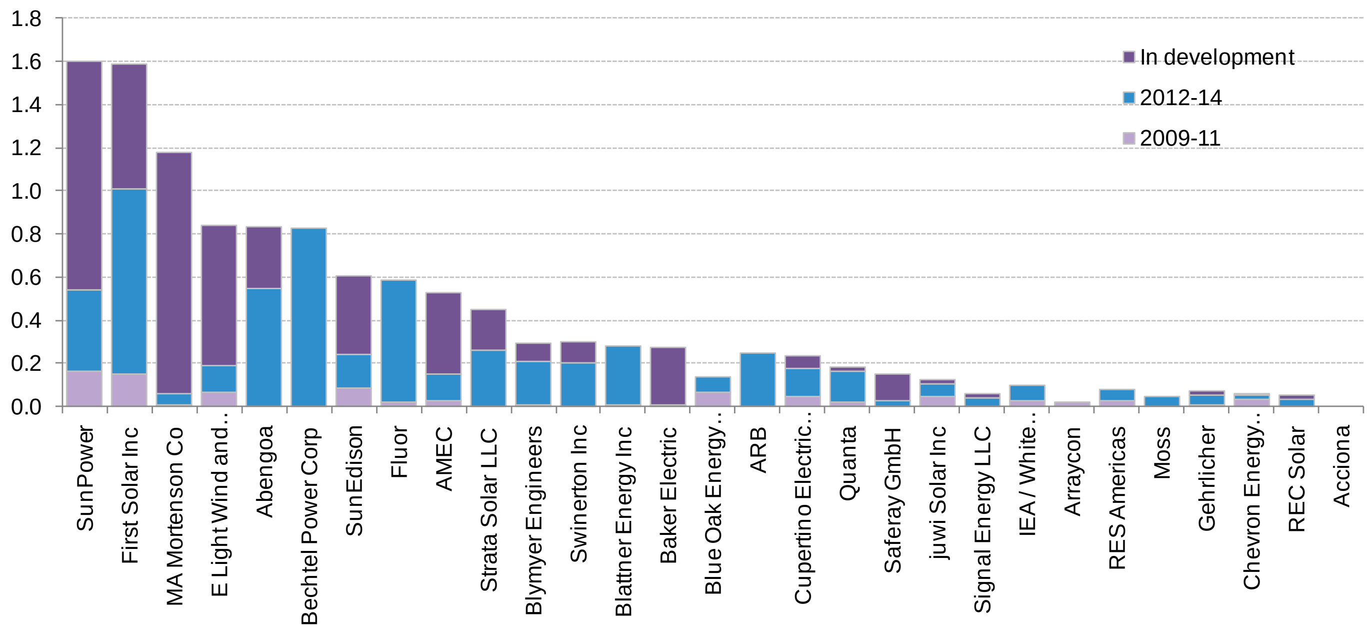
Figure 12: Commissioned capacity of top six US wind EPC firms by commissioning year, 2006 – 2014 year to date (GW)



Source: Bloomberg New Energy Finance, company websites. Notes: (1) Blattner activity is under-represented. (2) See Appendix B: Methodology for analysis of EPC players.

Figure 13 shows a time-weighted analysis for solar players.

Figure 13: Commissioned capacity and development pipeline for top US solar EPC firms by commissioning date or development status (GW)



Source: Bloomberg New Energy Finance, company websites. Notes: (1) Columns do not move monotonically down (ie, Blue Oak's is lower than ARB's) because some projects are not in our Industry Intelligence database, and excluded from this analysis (but those projects are included when we determine overall company activity, and this chart is sorted by that variable). (2) See Appendix B: Methodology for analysis of EPC players.

The top four firms in terms of overall solar activity have a vigorous pipeline, with hundreds of megawatts of projects in development. (Since EPC revenues are usually accrued as the project is completed, these firms have probably captured only some of the revenue associated with these engagements.) Other companies that are more heavily weighted towards capacity under development rather than already commissioned projects include SunEdison, AMEC, Baker Electric, and saferay.

Bechtel does not currently have any disclosed projects in its pipeline; the company thrives on very large projects, but new opportunities for these have become scarce. Other big players with little to no solar projects currently in the works are Fluor, ARB, IEA, and RES Americas. At least one player, Chevron Energy Solutions, is no longer active; Chevron divested this business earlier this year and is concentrating its power-related efforts on internal initiatives.

4.2. STRATEGIES AND DIFFERENTIATION

This section aims to identify characteristics that set EPC firms apart from each other. Some of the most important characteristics for differentiation have been alluded to earlier – including company size, reputation, and bonding capacity. We list and explore several others below.

Breadth of services

Firms can distinguish themselves with the breadth or narrowness of their offerings (Table 2).

Table 2: Breadth of services for selected EPC firms that are active in US renewables

	Subcontracting (primarily)	Full EPC	IP / Manufacturing	Project development	Financing	O&M	Project ownership
Blymyer Engineers	Engineering						
Dashiell	Substation specialist						
Barton Malow	Construction						
Rosendin	Wind (electric BOP)	Solar					
IEA		■					
Mortenson		■					
Swinerton		■				■	
Quanta		■				■	
AMEC		■				■	
Fluor		■			■	■	
Bechtel		■			■		
RES Americas		■		■	■	■	
First Solar		■	■	■	■	■	
SolarWorld		■	■	■	■		■
SunEdison		■	■	■	■	■	■
SunPower		■	■	■	■	■	■
Abengoa		■	■	■	■	■	■

Source: Bloomberg New Energy Finance, company websites. Notes: (1) Assessment of breadth of services is based on our interpretation of companies' representations of themselves on their websites and may be incomplete. (2) 'IP / Manufacturing' refers to key components – ie, intellectual property related to, and/or manufacturing of, modules (or parts of modules), turbines, and key components in solar thermal electricity generation systems; it does not refer to proprietary software or BOP/BOS components. (3) First Solar tends to sell its projects after commissioning, hence the blank cell under 'Project ownership'.

Some of the companies on our list are primarily subcontractors with one area of specific expertise. (Our research focused on companies with full EPC capabilities, and the list of subcontractors in the industry is more extensive than the few we examined, with specialties ranging from cranes and rigging to road construction.)

An alternative positioning is for companies that span a breadth of services for projects, including not just EPC but also operations and maintenance (O&M) and maybe even other services. RES Americas, for example, bills itself as a 'services company', able to support its clients with EPC, O&M, and even project development itself. Vertically integrated companies can serve as EPCs for their own projects (more on this theme in Table 3).

Project size

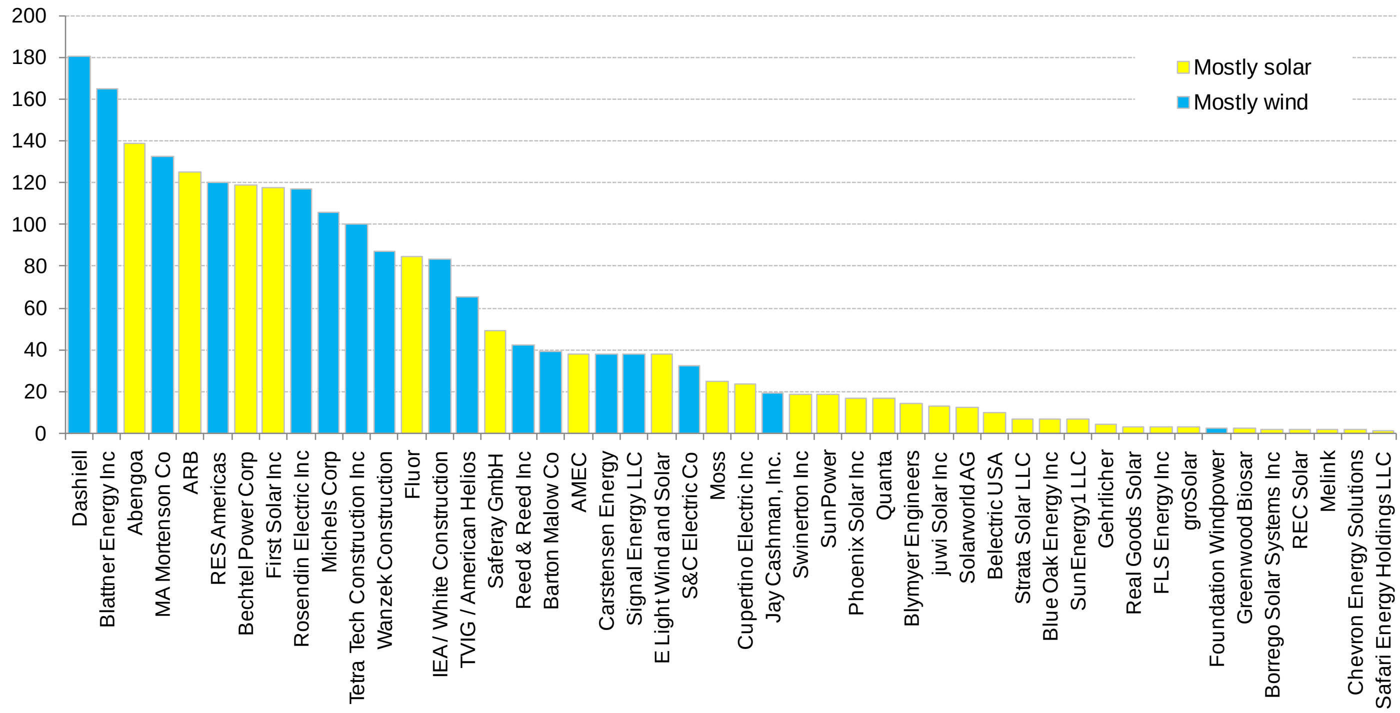
Figure 14 shows average project size for each EPC. The primary EPCs that service the largest wind and solar projects include some of the biggest names in the business. Blattner has built the five largest wind farms in the US, including the enormous 845MW Shepherds Flat project in Oregon and the multi-phased 1.5GW Alta Wind project in California.

The left end of the chart, showing the EPCs with the highest averages, also bears the imprint of solar thermal electricity generation (STEG). Companies that have been involved with STEG projects include Blattner (250MW Genesis plant, with ARB as a subcontractor), Abengoa (280MW Solana plant and 250MW Mojave plant), and Bechtel (392MW Ivanpah plant). At present, there is not much of an active development market for these types of projects.

The right half of the chart is mostly populated with solar-focused firms, with two exceptions: Jay Cashman which performs EPC for wind in the Northeast (where siting is a problem, so projects tend to be medium-sized), and Foundation Windpower (specializing in very small installations).

There is a meaningful niche for solar in the 1-10MW range. Strata Solar's average project size is 5MW (excluding one anomaly in its portfolio of 66 projects, the 65MW (AC) Duplin project); not coincidentally, North Carolina projects sized below 5MW can be eligible for 'qualifying facility' status. FLS Energy and SunEnergy1, in the same state, have similar profiles. Gehrlicher has specialized in installations atop IKEA rooftops, and Safari atop malls in New Jersey.

Figure 14: Average project size for 48 US EPCs (MW per project)

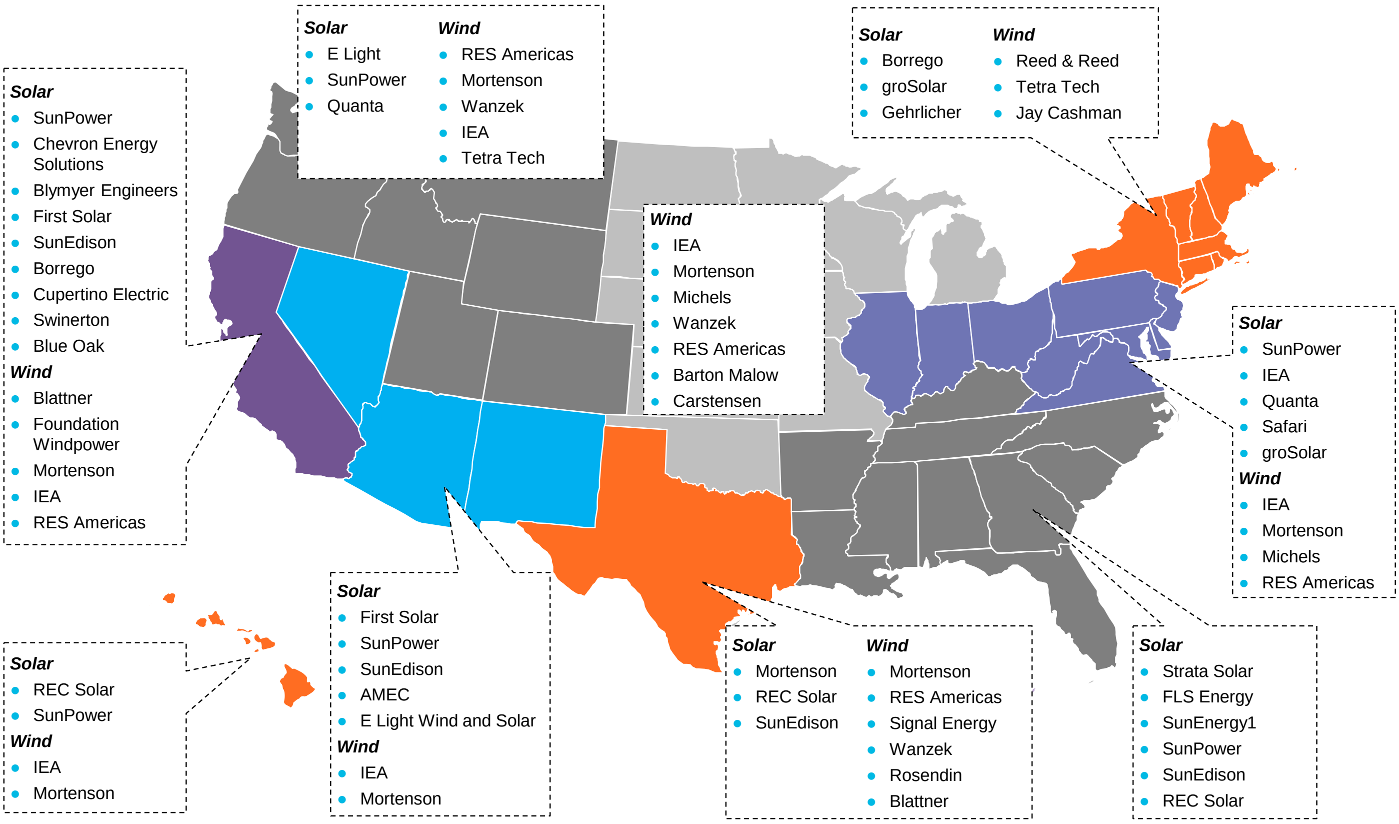


Source: Bloomberg New Energy Finance, company websites. Note: See Appendix B: Methodology for analysis of EPC players.

Geography

Regional specialization can reflect a focused sales strategy, an intentional effort to develop competencies applicable to the idiosyncrasies of a region, or an operational constraint (eg, EPCs may only be licensed to operate in certain states). Figure 15 shows the top EPCs, by number of projects for each technology, across regions in the continental US and Hawaii.

Figure 15: Top EPC firms by US region (by number of utility-scale solar and wind projects)

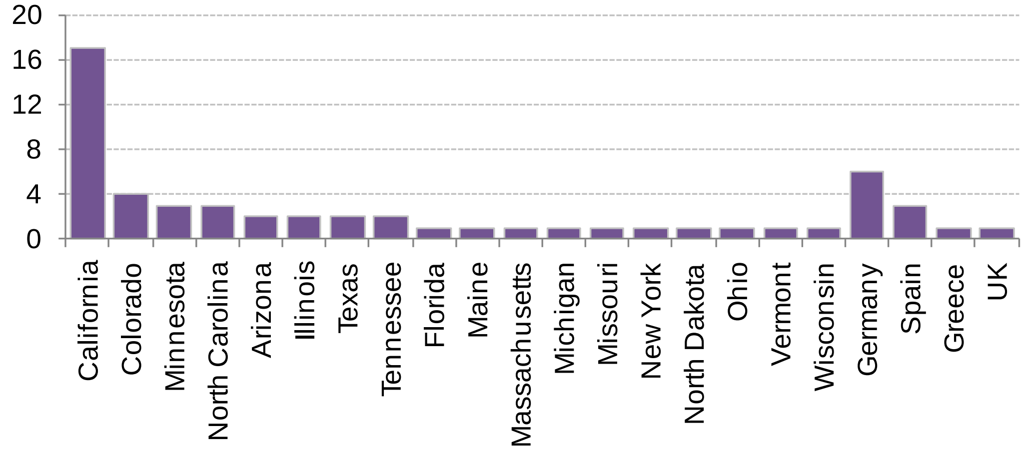


Source: Bloomberg New Energy Finance, company websites. Notes: (1) To date, there has been minimal utility-scale solar activity in the Midwest and minimal wind activity in the Southeast. (2) Blattner ranks eighth for wind in Texas according to our bottom-up tabulations, but Blattner is under-represented, and is known to have especially strong presence in Texas. (3) See Appendix B: Methodology for analysis of EPC players.

Some big EPCs have wide-ranging geographic appetites, following their customers across a diversity of regions (or developing their own pipelines in the case of First Solar, SunPower, and SunEdison). California, the hotbed for US renewables activity, features most of the largest players and also features some specialists in small and medium-sized solar (eg, Swinerton, Cupertino Electric). The Southeast and Northeast have their own unique roster of most active firms, reflecting the specific types of projects that get developed in these regions.

Another way of mapping geographic preference is by taking stock of company headquarters locations (Figure 16). The emphasis on California is evident, but other less obvious locations have high representation: Minnesota has a legacy of being home to construction firms; Colorado has progressive policy for renewables; and North Carolina has an attractive and peculiar market for solar, calling for on-the-ground presence.

Figure 16: Location of company headquarters for 56 EPC firms that are active in US renewables (number of companies with headquarters in that state or country)



Source: Company websites. Note: For companies that have US division but have European parent (eg, Abengoa, SolarWorld, Elecnor, juwi), we assign company headquarters location to the European base. For companies that are owned by a US parent which has headquarters in another state, we assign company headquarters location to the subsidiary's *location (eg, Wanzek in North Dakota though its parent company is in Florida, Quanta Power Generation in Colorado though its parent company is in Texas).*

Company placement can probably also be a calling card for business development purposes, especially when working with regulated utilities. Six out of Barton Malow's seven wind projects were undertaken in its home state of Michigan ("Consumers Energy hires Michigan company for new wind park" was the headline of a 2013 press release), and Wanzek Construction, a North Dakota-headquartered company, has performed a number of projects for utilities in the region, such as Montana-Dakota Utilities.

The chart of company headquarters' location also shows a notable presence from German and Spain-headquartered players. The two countries yield two different types of players: narrowly focused solar specialists from Germany (eg, Gehrlicher, saferay, and Phoenix Solar) and large infrastructure firms from Spain (Abengoa, Acciona, Elecnor).

Other forms

The table below expands on the ways in which EPC firms differentiate themselves in the market.

Table 3: Sources of differentiation for EPC firms active in US renewables: focus areas, strengths, and business development approaches

	Area	Description	Example company	Applicable characteristic	Notes
Focus areas	Geographic focus	Focus on a particular region	Strata Solar	North Carolina PV	• Enables EPC firm to prioritize sales leads and build niche-specific expertise • Some regions entail specific challenges – eg, dealing with state tax equity in North Carolina or permitting in New England • See Figure 15
			Reed & Reed	New England wind	
	Project type focus	Focus on a particular type of project	• Borrego • groSolar • REC Solar • RGS • Safari	Commercial-scale PV	• Project focus enables EPC firm to build expertise, achieve construction efficiencies, and acquire understanding of customer type's preferences • Commercial-scale EPCs have become increasingly focused on their core business, in some cases selling other business units (eg, Borrego focusing on commercial-scale; REC Solar and groSolar selling residential businesses)
			Chevron Energy Solutions (but no	Rooftop PV on schools	

			longer active)		• See Figure 14
			Foundation Windpower	Small wind projects (1-10MW)	
	Sector focus	Focus on renewable energy and ‘adjacent’ sectors (eg, transmission, storage)	• E Light Wind and Solar • Signal Energy • RES Americas	Focused on US wind and solar, and other relevant sectors	• Demonstrates specialization; customers are assured that firm’s top people are focused on their needs • In some cases, these renewable energy-specialized firms are subsidiaries of larger companies with broader list of markets • Downside of specialization is exposure to risk of market ups-and-downs (eg, after PTC expiration)
Strengths	Track record	Demonstration of significant past experience	• Mortenson • IEA • Blattner • RES Americas	Recognized leaders in terms of wind build experience	• Top five players have an estimated 80% of the ‘known’ wind EPC market (ie, only counting the projects for which we know the EPC)
		Blue-chip customer base	Blymyer Engineers	Partnered with Chevron Energy Solutions	• In the case of large utility-scale projects, customers are project developers or other contractors…
			juwi	PSEG projects	
			Swinerton	Recurrent projects	
			Reed & Reed	First Wind projects	
			Cupertino Electric	Facebook, Google, and PG&E projects	• … and for smaller and commercial-scale projects, customers are rooftop ‘hosts’
			Gehrlicher	IKEA projects	
			Quanta	Kohls and Staples projects	
			SolarCity	Wal-Mart projects	
	Corporate credibility	Corporate parent is sizable and experienced	Bechtel	$38bn US private construction company	• High creditworthiness / bonding capacity • Message is “If we sign up, we get it done” • May be oriented towards larger projects which ‘move the needle’ at the corporate level – which means this segment may not be well-positioned for solar post-2016, when distributed generation build continues to grow and utility-scale slumps • Trusted by utilities, which tend to be conservative in vendor selection and want to be in ‘safe hands’ – eg, AMEC has performed EPC for Arizona Public Service, Dominion, Southern Company
			AMEC	$6bn UK-based public EPC	
	Client service	Value-added services beyond pure EPC	Bechtel	Financing support	• Has the capability to bring financing to get large projects done • Bechtel Enterprises was not just EPC vendor but also equity investor in Ivanpah solar thermal plant; we are not aware of other examples of this
			RES Americas	Development support services	• Company has a development team but is generally not interested in owning projects; company aims to provide services to long-term owners, including EPC, O&M, development, engineering
		Alignment with customer needs	Mortenson	Flexibility of delivery methods	• Seeks to accommodate customers with varying risk tolerances and budgets • Four different delivery methods: Lump-sum; Design-build; Agency construction manager; Construction manager at risk (see their diagram here)

			TVIG / American Helios	Suitability for federal government procurement	• TVIG (EPC for wind) and American Helios (its solar affiliate) are each Service-Disabled Veteran-Owned Businesses (SDVOSB); government agencies can use contracts with these firms towards meeting SDVOSB procurement goals
	Unique capabilities	Unique IP	Abengoa	Design and manufacturing of key technologies	• Unique home-grown technologies are used at their own plants but can also be sold or licensed to third parties (mostly oriented to solar thermal) • Also applicable to other Spanish infrastructure firms, as well as vertically-integrated solar EPCs
		First-of-a-kind projects	Fluor	Willingness to take on complex new projects	• Participated in UK offshore wind project (have now exited) • Other very large EPC specialists, such as Bechtel, also fit here
Business development approaches	Partnerships	Formal or informal partnerships with developers	saferay	Joint agreement with 8minuteenergy to develop and build project	• Thousands of examples of companies subcontracting others to deliver a project, but we are not aware of specific examples of contractors partnering with each other to pursue business development opportunities
		Formal or informal partnerships with other contractors	Swinerton	Blymyer Engineers as engineering subcontractor on many projects	
	In-house channels	Developer affiliates	Jay Cashman	Affiliated with Patriot Renewables	• There may be cases where one entity (eg, either the developer or the EPC) is a loss leader to enable business development for the other entity (not necessarily the case in these examples)
			Greenwood Biosar	Affiliated with Greenwood Energy	
		Vertical integration	• First Solar • SunEdison • SunPower • SolarWorld	End-to-end (panel manufacturing, development, O&M, and sometimes ownership)	• EPC may be the least lucrative part of their business (and the companies may even be doing this service for a loss) • Development (and EPC) is often mostly a channel to ensure demand for modules
			• Gamesa	Example from the wind industry	• Vertical integration for wind (turbine manufacturer doing development and installation) is not common in the US; more so in emerging markets

Source: Bloomberg New Energy Finance. Note: The areas of differentiation are not exhaustive, and they are based on our interpretation of companies' representations of themselves on their websites.

APPENDICES

Appendix A: The basics

What do EPC firms do?

An *engineering, procurement and construction (EPC)* firm is contracted by the developer or owner of a project to carry out the design, equipment procurement and physical construction of the plant. This encompasses most of the steps in the commissioning of an energy projects that do not fall into the arena of financing or development (eg, fundraising, permits, legal – these are typically undertaken by the developer). EPC functions are combined into three broad categories: engineering, procurement and construction.

- **Engineering (E)**: this includes initial planning, design, technical analysis and cost estimation of the project, and is crucial in determining its valuation and length to completion. It begins with a feasibility study to address two main questions: (i) what is the estimated capex? and (ii) how much output can be generated over a project's lifetime? This can range from a week-long study for a rooftop solar system to a multi-yearlong analysis for large wind projects. Consideration is given to everything from available wind or solar resources to drinking water access for the labor force. The deliverable is the completed design of the plant, which includes physical layout, number of modules and inverters (for solar), number of turbines (for wind), substation network, collection systems, access roads, and other elements.[10]
- **Procurement (P):** this entails the purchase and allocation of all required physical equipment and labor to build the project. This includes renting or leasing the construction gear (eg, cranes, trucks), hiring and organizing the labor force, and buying the plant infrastructure (eg, racking, inverters, cables, modules). In many cases, this also includes engaging subcontractors for portions of the construction work. A major component of the procurement process is to ensure that the right equipment arrives at the right time; all procured items should arrive just in time for use or installation to avoid storage costs.[11]
- **Construction (C):** this is the *hard-hat* work or physical building and installation of the project. The construction company may be an energy infrastructure specialist or a general contractor. The contractor or project manager will usually subcontract specific tasks to other companies. It is rare even among the biggest construction firms that one company perform all tasks in-house. For example, it is common for electrical and road work to be outsourced.

  The construction phase is sometimes shorthanded as the contract for *balance of plant (BOP)* for wind and *balance of system (BOS)* for solar.

  - **BOP:** all infrastructural components of a wind project apart from the turbine (eg, cables, access roads, crane pads, foundations, collection networks, substations)

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10 Some developers have in-house engineering capabilities that they supplement by subcontracting outside engineering firms – ie, the developers have high-level staff managers but outsource the on-the-ground work to other companies. This is especially important for national developers who would otherwise need to employ locally licensed engineers for projects located in different states (every state in the US has its own licensing requirements for engineers; one state's license does not translate to another).

11 As in the case of engineering, many larger developers handle parts of procurement in-house. This is particularly true for items with long lead times such as transformers, which could take up to a year to receive. In the case of wind turbines, developers sign separate contracts directly with the turbine manufacturer. The contract covers the sale of the item and typically includes delivery; at times, it also includes installation. Hence, the developer is ultimately responsible for procuring the turbine, and its costs are often excluded from the EPC contract.

- **BOS**: all components of a solar system apart from the modules (eg, cables, racking systems, wiring, land preparation, inverters)

EPC scopes differ by sector, company size, plant capacity, location, and other factors. For example, it is common for large wind developers to have in-house engineering and procurement capabilities and subcontract the construction phase (ie, in industry jargon, this developer does 'E+P' and hires out 'C'). Smaller solar developers often merge all EPC work into one process with little distinction from other development steps. To characterize the variety of structures in play in the US renewables market today, below we describe three representative relationships between developers and EPC firms.

Table 4: Examples of different relationships between developers and EPCs

Relationship	Description	Characteristics in the US renewables market
Developer hires turnkey EPC	The turnkey EPC contract includes all work associated with building the project; at the point of commissioning, the plant is ready for operation or sale. Turnkey EPCs are accountable for overall cost, performance and a significant amount of risk. (This does not preclude the EPC company from subcontracting portions of the construction phase. Typically, even the largest EPCs with full construction capabilities will still subcontract electric work and road construction because of the specificity of that particular task.)	**Wind:** Utility-scale turnkey contracts in this sector are rare in the US, especially among larger national developers, which have some internal EPC resources. However, they are popular in emerging markets where the developer is unfamiliar with local rules and procedures. **Solar:** A number of solar developers choose full turnkey contracts. It is easier to for the EPC to provide a performance guarantee if they also procure the modules. **Small-scale solar:** Some small-scale solar developers perform turnkey installation (eg. developer and EPC are the same).
Developer with in-house E+P hires BOS/BOP	A developer with in-house engineering and procurement resources hires an EPC firm or general contractor to do the BOP/BOS work. The developer will complete most of the engineering and procurement and take bids from outside contractors for construction work. In a similar scenario, larger developers might also subcontract an outside engineering firm to oversee the on-the-ground work.	This is a common structure among larger solar and wind developers. **Wind:** The developer will be responsible for procuring the turbine through a separate contract with the turbine manufacturer. Most US contracts are delivery-only, though installation is often left to a third party. **Solar:** The developer could purchase modules directly from the manufacturer but this might affect the performance guarantees that the EPC is willing to provide.
Vertically integrated manufacturer, developer and EPC	In this arrangement, all steps to commissioning are completed by the developer apart from some minor subcontracting in the construction phase.	**Wind:** There are no US wind companies that fall into this category. Gamesa and Acciona manufacture, develop, and can perform E+P, while outsourcing most of the C. **Solar:** Large solar companies – such as First Solar, SunPower, SunEdison, and SolarWorld – tout this end-to-end capability. The downstream business (development and EPC of solar projects) can provide the company with revenue diversification and ensure a channel for their products.

Source: Bloomberg New Energy Finance, interviews with market participants

Contract elements

Contracts can differ considerably depending on the relationship between the developer and EPC, as well as the project size, location and risk appetite of the relevant parties. A cheaper contract by total price might not include certain guarantees or physical components, such as a substation or transmission lines. In another example, an EPC contractor may include some assistance in the development phase (eg, permitting) but not price it into the line item of the final agreement.

That said, there are a number of contract components that can be considered 'standard' for the industry. Below, we highlight a selection of the most common features:

Table 5: Selected elements from a typical EPC contract

Feature		Explanation	Characteristics
Liquidated damages	Contractual penalties agreed to by both parties before work begins		Typically, total penalties are capped at a percentage of the total EPC contract (see 'Caps on liability' below).
	Delays	Penalties for delays in the completion of the	The per-day rate covers damages due to lost revenue,

Feature		Explanation	Characteristics
		project. This is usually measured as a per-day fee for every day past a fixed completion date.	extra insurance paid, financing fees. Importantly, it does not include any losses due to missing the all-important deadline for expirations of key federal tax credits.
	Performance	Penalties imposed when generation does not meet the performance guarantee	n.a.
Warranties / Guarantees		EPC warranties may include: • Design and construction in compliance with laws and permits • Project performance • Equipment quality – ie, components are new and undamaged (equipment warranties are typically provided by the equipment manufacturer, but are usually addressed in the EPC contract) • Subcontractor warranties • Workmanship / material guarantees offered by the provider of the BOP/BOS	For solar, typical length for EPC warranties is 3-5 years. For solar, EPCs will only provide a guarantee on modules if they also procure them. (If the developer chooses to procure their own modules, the EPC may need to perform additional audits that include visiting the manufacturing factory.) The length of workmanship / material guarantees typically lasts 12-24 months after commissioning. The contract might also include a provision to give the EPC a chance to 'fix' problems (eg, if generation is below the performance guarantee, the EPC can re-adjust the modules before it is forced to pay damages).
Single point of responsibility		Accountability for all aspects of the EPC phase	The EPC is responsible for any problems, even if they originate with an outside company.
Fixed contract price		A lump-sum payment for all EPC work. In this case, the EPC contractor is responsible for any cost overrun and delays but also benefits from being under budget and ahead of schedule.	Because of the nature of the fixed-price structure and the risk it imposes on the EPC, a risk premium is built into the final price. Developers are willing to pay because it also offers them security and price certainty.
Fixed completion date		A guaranteed date to complete the project. Any delays afterwards, and the EPC would be liable for liquidated damages.	This is particularly important for projects rushing to meet a deadline for incentives.
Caps on liability		A cap on the total amount of damages for which the EPC is liable. Caps range widely and may include sub-caps for various types of damages.	A total cap might be as high as 100% of the EPC price. A sub-cap might be 5% for damages arising from delays.
Security		An added security by a third-party to pay damages to the developer. If the EPC cannot or will not cover damages or other obligations, a security policy offers additional protection to the developer. This usually takes the form of a guarantee from a bank or a larger parent company, or a surety policy.	This is also referred to as *bonding* and the amount of coverage is called *bonding capacity***.** Bonding capacity is an important risk consideration for the developer and financier – the higher the bonding capacity, the higher the pay-out for damages.
Variations		Acceptable variations to the project are agreed upon beforehand and can be implemented without additional approval. For example, an EPC can change a subcontractor or tweak the design. This may result in additional costs.	Developers usually seek out EPCs with a reputation for few variations, and hence few changes in the final price.
Defects liability		An added guarantee for any defects for the first 12-24 months. This is sometimes also called a workmanship and material guarantee.	n.a.
Intellectual property		IP for the design drawings drafted by the engineer	If a project is designed well, a developer may want to recreate a similar project. However, the ultimate design belongs to the engineer and the developer will need to rehire them or be content with a different plant design.
Force majeure		A provision that states the EPC is not liable for losses incurred due to a *force majeure* or major and unavoidable event	While some events seem obvious (eg, natural disaster), others – such as labor disputes – are more ambiguous.
Termination		Predetermined rights by each party to terminate the contract	Typically, the developer has more cause to terminate the contract than the EPC, who is limited to delinquent payment, breach of contract or *force majeure*.

Source: Bloomberg New Energy Finance, 2011 DLA Piper EPC Contracts in the Power Sector, interviews with market participants

Table 6 outlines the process to develop a solar or wind project from the point when EPC work begins to the final commissioning of the plant. It highlights important aspects about each step, including which of the players performs the task. This list is an attempt to organize the steps in chronological order but, because of the complexity of the process, many are performed simultaneously.

Table 6: Steps to commissioning

Steps	Notes	Who does it?	Relevant sector
Hiring the EPC	There is no standard when hiring an EPC. Sometimes, the developer has a strong relationship and goes straight to the firm. Other times, it calls for bids from competing companies.	Developer	Wind and solar
Feasibility studies and resource analysis	This is the preliminary step in the engineering phase. It is the most crucial in determining the overall project costs and output over its lifetime.	E	
Financial analysis and procurement capabilities	This is typically done in conjunction with the developer (who is working with financiers), based on the information collected from the feasibility study.	EP and developer	
Permits, approvals, legal	The developer obtains many of the initial permits and approvals. The EPC may need to obtain additional ones specific to construction work. This step can also be difficult when dealing with local labor laws.	Developer (sometimes EPC)	
Site planning including storm water management	This is particularly important for desert facilities which are subject to flash floods.	E	
Electrical system design (inverters)	A well-engineered project takes care to match up equipment to avoid extra capex costs. (For example, for an 80MW PV facility, the EPC needs to determine the cheapest option – eg, (i) three 25MW inverters and one 5MW inverters or (ii) four 25MW inverters.	E	
Racking system design	A well-engineered project attempts to reduce racking equipment while keeping AC capacity the same.	E	Solar
Solar PV foundation design	The PV plant foundation can be a simple function. However, it can be costly and complicated for hillier and colder regions.	E	
Procuring wind turbine	The developer typically procures turbines directly from the manufacturer. (Some EPCs have performed this function as well.)	Developer (sometimes EPC)	Wind
Procuring PV modules	Modules can be procured by the EPC or the developer. If done through the EPC, it will provide a performance guarantee.	P (sometimes developer)	Solar
Access road network design and installation	It is common for this task to be subcontracted by the BOS contractor. The work usually goes to a company specialized in civil construction or a local firm. It is more relevant to large wind projects, which are often located in isolated areas far from main roads.	BOS	Wind (less so for solar)
Wind turbine generator foundation design and installation	Turbine foundation work, which is separate than turbine installation, can be performed by the BOS company or a subcontractor specializing in cement.	BOS	Wind
Generation tie line connection	The tie-lines connect the collection system substations to the transmission grid. This can be an expensive component of the project depending on the distance to the nearest transmission line.	BOS	Wind (less so for solar)
Utility interconnect design and construction Substation and interconnection facilities	Electrical work requires a certified electrician and specialist in power connections. This particular step is more complicated because it physically connects the plant to the utility grid.	BOS	Wind and solar
Assembly of collection system	This is the entire underground cabling system within the boundaries of the actual plant. This 'collects' the power before sending it to the grid.	BOS	Wind and solar
Assembly and module mounting	Assuming the racking design is in place, this can be a simple and often quick process, which entails placing the panels into their mountings.	BOP	Solar
Turbine erection	Turbine installation is a complicated step that involves cranes and specialized labor. Installation may be performed by the contractor and supervised by the manufacturer, who is typically onsite during the process.	BOS, Turbine manufacturer	Wind
Mechanical and electrical completion	This is the final step or the commissioning of the project. For a wind project, the turbine manufacturer is sometimes present at the site to ensure the equipment is performing to specifications.	*Wind*: E+C, and turbine manufacturer *Solar*: E+C	Wind and solar

Source: Bloomberg New Energy Finance, 2011 DLA Piper EPC Contracts in the Power Sector

Appendix B: Methodology for analysis of EPC players

We have based our analysis of EPC firms mainly on data gathered from companies' websites as of August 2014. The table below explains our approach and notes caveats to the analysis.

Table 7: About the methodology for our analysis of EPC players

		Explanations and caveats
Defining the universe of players		• We focused on EPC firms with meaningful activity in utility-scale solar and wind • Began with a list of top 30 firms based on their recorded activity in our project database (not a comprehensive list, since many projects did not have EPC filled in, but a starting point) • Supplemented the list with other key players (because their activity is sizable or they occupy a unique niche) • Selectively included some subcontractors – either because their services bleed across subcontracting and pure EPC, or because they surfaced frequently in our analysis of EPCs • The universe of EPC firms included in this study is far from comprehensive; while we think we are capturing all of the pure EPC firms that are in the top ranks (in terms of capacity built) for wind, and most of the top-ranking EPC firms for solar, we are missing some with moderate amount of activity and missing many subcontractors • Our list of solar EPCs includes the top 16 from Solar Power World's list of the top 400 solar contractors, with the exception of NRG
Defining the universe of projects		• We considered any utility-scale (>1MW) solar or wind project in the US (excluding territories) • Solar includes solar thermal electricity generation, but not solar water heaters • Some of our charts mention 'active' projects – this means projects that are either operational ('Commissioned') or at various stages of development: 'Announced', 'Permitted', 'Financing secured / Under construction'
Calculations of capacity and number of projects		• In a small number of cases, projects on which EPC firms had worked did not appear in our database (usually projects below 5MW). For these projects, we included them in our analysis of overall activity (Figure 8, Figure 9, Figure 10, Figure 11) but not in the analyses that require an understanding of the project's status, size, or location (Figure 12, Figure 13, Figure 14, Figure 15) • For the project counts, each phase of a project is counted as a unique project • For the project capacity calculations, if more than one contractor worked in the project (eg, EPC and subcontractor), all parties receive full credit • In some cases, our figures for capacity differed from companies' reported figures; these differences were usually very slight (eg, <10% difference), and we usually used our figures • With very limited exceptions (see below for 'Special cases'), we only give credit on a *bottom-up basis* – ie, we only give credit to capacity sums and project counts if the actual project is disclosed. (Some companies do not provide the name of the project and keep it confidential, but we are almost always able to identify the project anyways based on the clues provided.) • As an example to the above, though S&C Electric says it has done interconnections for 2.7GW of renewables, we only give credit for the 440MW of disclosed projects. And though Henkels & McCoy says it has "wired over 2,000 turbines on over 25 different projects", we do not count any of them as they do not disclose which projects
Special treatment for certain players	Blattner	• Blattner is under-represented in our rankings. The company is a major player in wind – it claims to have done more than 21GW across North America and probably has about a third of the market – but in our rankings of project experience, we only count the 4.5GW disclosed. The company declined to share more details. In certain cases of this report, including the Executive Summary, we identify Blattner as among the leaders, even if the disclosed numbers put them behind other companies.
	First Solar, SunPower, SunEdison	• For these three players, we made a unique exception. They are important firms, so we want to capture their activity, but their disclosure on specific projects tends to be limited. (These companies either did not respond to request for more information, or did respond but explicitly declined to provide more details.) • So **for these companies, we have had to make some assumptions**: - In cases where the description in our project database suggests that one of these companies was the EPC (ie, if the description says that the company performed the EPC, or was chosen to perform the EPC, or was planning on serving as the EPC), unless we learn otherwise, we assume the company actually was the EPC - In cases where one of these companies was involved in any way in the project, we mapped the project to one of 78 possible combinations. The combinations are defined by 10 parameters: developer, equipment provider, subcontractor, EPC, project owner (and parent companies / acquirers of each of these). Examples of combinations include: ▪ SunEdison (or company / portfolio bought by SunEdison) as developer; First Solar as equipment provider ▪ SunPower (or company / portfolio bought by SunPower) as developer and as equipment provider - We then looked at case studies that fit that combination and looked for a trend in terms of the *known* EPC for that combination. If there was a trend, we assign all projects that fit that combination to that EPC; if not, we made assumptions (eg, projects developed and owned by SunEdison had SunEdison as EPC)

Source: Bloomberg New Energy Finance

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