



STANLEY®
Engineered Fastening

Cost & Competition in Renewable Energy

How alternative and renewable energy plant installers can reduce costs as competition grows.



These could be heady years of growth for renewable energy, especially solar and wind.

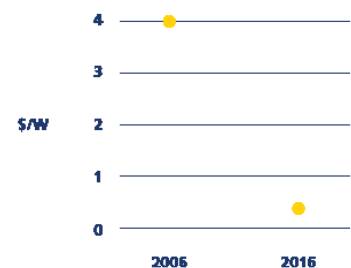
Worldwide, there are three factors driving its growth: the urge for developing countries to gain access to modern energy sources, especially electricity; the search for carbon neutral and non-polluting energy; and the decreasing costs for both solar and wind.

However, despite or even because of growth, pressures remain for the industry.

One of those pressures is the changing attitudes for government support. There is no question that it has contributed to the growth of renewable energy technologies. The idea behind government support was to jumpstart the industry, allow it to establish itself while reducing costs, and then fade out as solar and wind became competitive with existing conventional technologies. In theory, as costs drop, government support should fade away.

Costs are indeed dropping. In some cases, dropping dramatically. A report from Navigant Consulting notes solar panels made of crystalline silicon dropped their costs from roughly \$4/W in 2006 to, in some cases, below \$0.40/W in 2016.¹ “We’ve seen costs drop to as low as \$0.35/W as recently as December of 2017,” said Roberto Rodriguez Labastida, Senior Research Analyst, Navigant Consulting.

CRYSTALLINE SILICON
SOLAR PANELS PRICING



In some areas of the world, new solar or wind projects are almost cheap enough to compete directly with brand new coal-fired plants, even in the absence of government subsidies.

Navigant claims that “lower prices are opening new markets for distributed photovoltaic (PV) while also helping the technology reach grid parity more quickly in high-cost retail electricity markets.” Wind turbine costs have been dropping as well, though maybe not as dramatically. According to the International Energy Agency’s *World Energy Outlook 2017*, wind costs have decreased by 25 percent since 2010.

Seb Henbest, lead author of the *2017 Bloomberg New Energy Outlook* report, states in some areas of the world new solar or wind projects are almost cheap enough to compete directly with brand new coal-fired plants, even in the absence of government subsidies. “In Germany, new onshore wind and solar already appear to be cost competitive with new coal and gas,” he told *Bloomberg New Energy Finance*.² He predicts that wind and solar will compete in China and the U.S. against new-built plants in just a few years. By 2030, they may well be cost-effective enough to begin closing existing coal and gas-fired plants.

The impact of government support (and uncertainty)

The very success of renewable energy technologies in reducing their costs has forced governments at the state and federal levels to reevaluate their support for solar. Feed-in tariffs (FITs) have been largely curtailed or replaced by reverse auction systems, and net metering policies have been revised to ensure that solar installations contribute to the cost of maintaining and upgrading the electricity grid.

Much the same is true for wind. A recent article in *Bloomberg Businessweek* observes that governments are turning to market solutions, not fixing the price of clean electricity.³ Developers are increasingly asked to compete against each other to win the right to build projects. The switch to such auctions has sent prices for power from onshore wind down as much as 60 percent and solar by half in some markets, according to *Bloomberg New Energy Finance*.

Navigant also reports that new business models, such as solar leasing, are slowing. Integrated solutions to improve self-consumption and virtual power plants are emerging, but at present are unproven at large scale. The concept of a virtual power plant is a cloud-based distributed power system that aggregates the capacities of different distributed energy resources to give a reliable overall power supply. The concept often revolves around controlling wind, gas, PV and other sources to deliver peak load or load-following power generation, ideally on short notice.

“We’ve seen that legislation, such as the Solar Investment Tax Credit, has a tremendous impact on build rates and creates quite a bit of volatility amongst our current and potential customers,” said Dan Tuerk, Business Development Manager at STANLEY Engineered Fastening.

Cost is a challenge that remains

Like any commercial enterprise, total cost of ownership is often more important than initial price, which is why engineers are looking carefully at all elements of infrastructure, from materials to fasteners. One of the most important measures is the levelized cost of electricity (LCOE). It’s the sum of the cost over a project’s lifetime divided by the sum of the electrical energy it produces – the lower the LCOE, the better. The LCOE is calculated over the design lifetime of a plant, which can measure in decades, and is priced in \$/kWhr (or the monetary unit used in the country).

While it has its limitations as a comparison tool, it does highlight that costs – no matter how they might be used in a calculation – need to come down while capacity for the unit to produce energy needs to go up.

There is also a difference in costs between utility-scale solar installations – massive centralized installations – and distributed solar installations near the point of use. Labastida notes that worldwide there's slightly more utility-scale installations than distributed – about 60 to 40 percent. "In developing countries, utility scale is the most common type of solar energy," he said. Companies are competing to deliver specific capacities, putting pressure on the cost of solar. It's had results, too. "You can see places where solar costs less than 2 cents per kWhr. The first time that happened was six months ago in Dubai. Then, it happened again in Chile in September 2017. And again, in Mexico in December 2017," Labastida explained.

Distributed remains more popular in industrialized countries. Governmental policies and other factors account for this.

Labastida is also quick to point out that while a utility-scale installation may be cheaper to produce electricity, there's still the cost of transmitting and controlling it to its point of use. Most installations are connected to a grid and intended for broad use, rather than on-site by a factory.

Containing cost is as true in small things as large. In fact, cost reductions are often the accumulation of many details that in sum yield big results. This could be in incrementally more efficient motors, installation designs, materials, site selection, and sundry other details. Fasteners are a good example, one of the many small details that could figure into a sum of large gains.

The opportunity is in the details

A solar PV installation requires panels to be mounted, wire harnesses to be attached, and supporting structures to be held in place. Not only must they last for the lifetime of an installation – which is typically decades – inordinate cost can be caused by inefficient fastening and difficult installation procedures.

While a utility-scale installation may be cheaper to produce electricity, there's still the cost of transmitting and controlling it to its point of use.

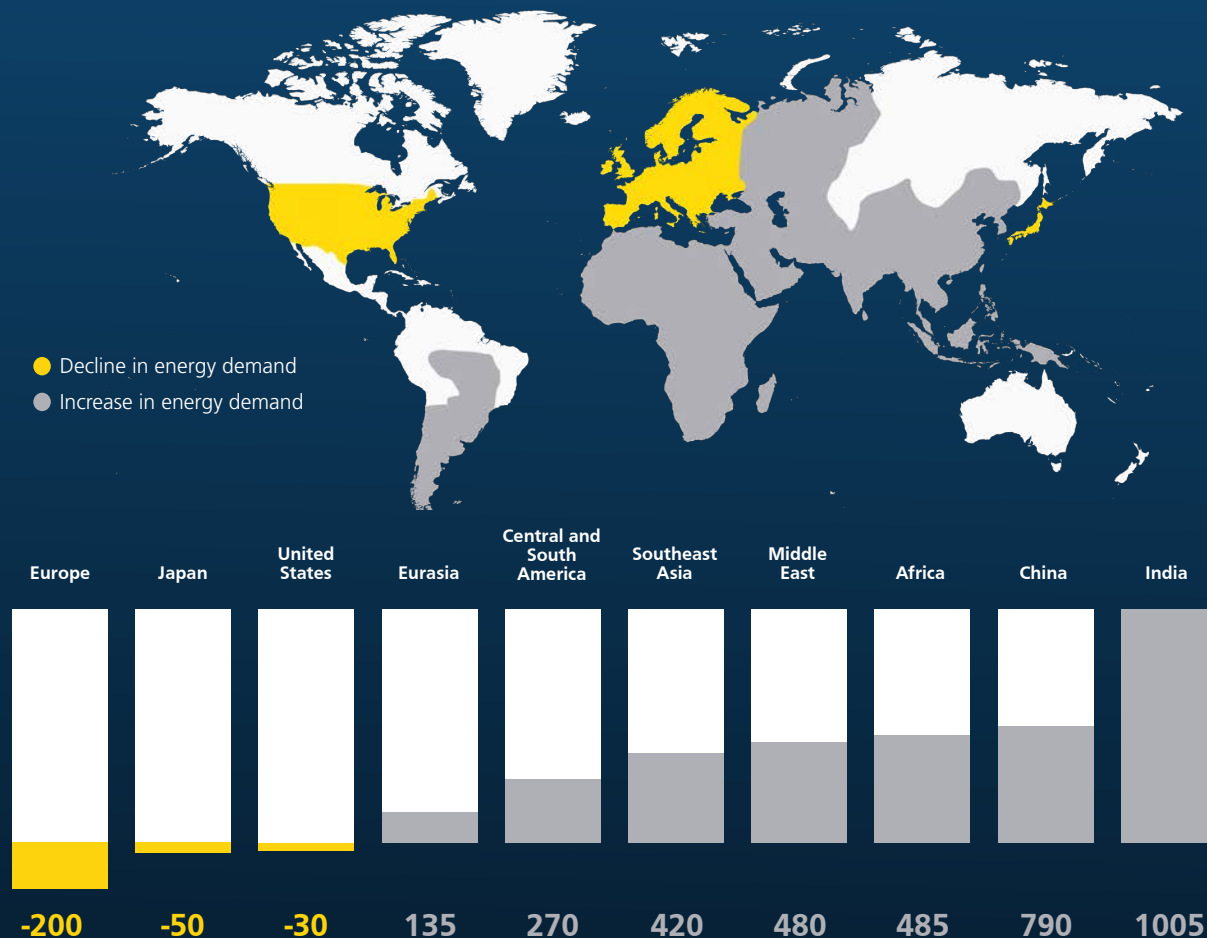
STANLEY Engineered Fastening is viewing the renewable and alternative energy market as an important market, one needing new solutions. "It's still an incredibly fragmented industry but one that's thirsty for solutions. [Project developers] are engaged in a race to the bottom of installed costs while managing oversight from various bodies," explained Tuerk. "For us at STANLEY Engineered Fastening, the opportunity is to develop a comprehensive Value Proposition that can be adopted across the market for specific repeatable joints. This will help drive down Balance of Systems (BoS) and LCOE costs for our customers." Tuerk's recommendations for containing costs include reducing part numbers for field assembly and eliminating expensive components in a given joint.



ENERGY GROWTH IN THE 21ST CENTURY

Change in primary energy demand, 2016-40 (Mtoe)

World Energy Outlook 2017



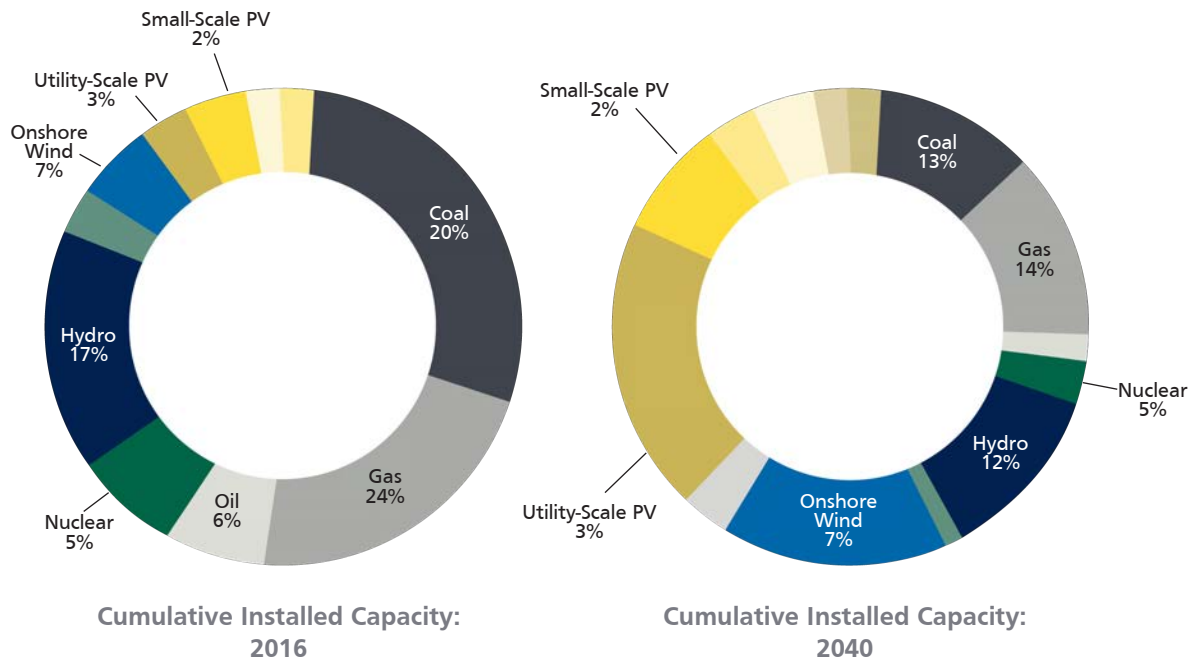
An International Energy Agency projection for growth in energy demand, given certain assumptions.

The growing energy demand is the backdrop against which a market in renewable energies must be put in context. The IEA projects that the demand for energy in most advanced economies will gradually decline, despite growth in national output. This is because GDP growth in advanced economies will not be in energy-intensive industries, and most residential uses of energy are already installed. Conservation measures will increase as well.

Not so in the developing world, where residential energy, especially electricity, will need to be expanded in keeping with the aspirations of their citizens. The IEA is also predicting that developing nations will expand energy-intensive industries. However accurate the numbers are in the graphic above, developed using scenario modeling, it's easy to predict that the relative growth of each region is reasonable, with India anticipating a huge investment in energy.

The type of energy is important as well. Electricity is the rising force in energy use, replacing oil in transport (think electric vehicles) and natural gas in other areas such as heat, cooking, and industrial uses. According to the IEA, global investment in electricity overtook that of oil and gas for the first time in 2016.

A LOOK AT THE NUMBERS



The 2017 Bloomberg New Energy Outlook predicts investment for new power generation to grow to \$10.2 trillion by 2040. Even more importantly, 72 percent of that will be in renewables. Solar will absorb \$2.8 trillion and wind \$3.3 trillion.

This is backed up by a 2017 report on solar PV from Navigant Research, which expects the adoption of solar PV to increase rapidly during the next decade. Wind power is growing as well.

Another report also predicts growth in renewable energy. Navigant Research's 22nd World Wind Energy Market Update states global new wind capacity added in 2016 rose to 486,831 MW, a 12.1 percent annual increase over the previous year.

It's how solar and wind installations are built that lend themselves to innovative solutions in fastening. "A construction site is like putting together the pieces of a three-dimensional jigsaw puzzle," explained Sean McGain-Harding, STANLEY Engineered Fastening's Strategic Applications Director in Europe. Many of the parts are built in a factory, kitted together, and shipped to the installation site. They then must be assembled on the site. New fastening solutions can benefit either the factory or the site, or both.

Fastening can involve welding, rivets, or simple nuts and bolts. "The problem with welding is that it's not serviceable and it's often difficult to get the power needed to many of the sites where these are assembled," said McGain-Harding. Nuts and bolts, on the other hand, can be laborious to install and are subject to vibration loosening over time. Surprisingly, while important in wind installations, vibration loosening is also a prime concern in solar installations as well. For solar, the position of the panels is important relative to the sun. If the position is off by even a little, there's a loss of efficiency and output.

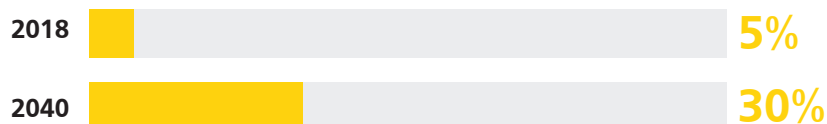
McGain-Harding was quick to point out that most fasteners in any renewable installation would not require on-going serviceability. However, resistance to vibration with any of them is vital, along with ease of installation and adaptability to a wide range of on-site conditions. "Say maybe 20 or 30 percent of the fasteners would need to be serviceable. So, in those cases, we'd use blind rivets or lock bolts," he said. Blind rivets, often referred to by the company's registered trade name as POP rivets, allow objects to be fastened together when access is only possible from one side.



“Prices for hardware like inverters have dropped 30 to 40 percent in the last 5 years. But, it’s the other parts, such as labor and project management that’s less flexible in price.”

*Roberto Rodriguez Labastida
Senior Research Analyst,
Navigant Consulting*

Installed Solar Energy



McGain-Harding points to the company's Spiralock® threaded joint for use in applications where heavy shock and vibration, extreme temperatures, long hours of strenuous operation, and millions of loading cycles are present. This describes any number of remote solar or wind electricity generating sites.

Another product McGain-Harding highlighted, the Neobolt® non-breakstem lockbolt fastening system, was created specifically for solar and wind installations. The two-piece fasteners feature unique design characteristics, such as annular locking grooves for vibration resistance, fatigue performance, and avoidance of loosening by unscrewing.

While these products in and of themselves reduce the total cost of ownership over the lifetime of a project, STANLEY Engineered Fastening is also aware of the costs of installation.

“We are developing a cordless installation tool. Historically most of our installation tools have been pneumatic or hydraulic, but you can imagine the problems they could cause at remote construction sites,” he said. “You really need a cordless tool.” To that end, STANLEY's first cordless installation tool will be tailored for Neobolt® and available in Q1 of 2018.

The need to reduce labor costs is also emphasized in general by Labastida. “It’s true that the costs of structure and overall balance of systems are improving,” he said. “Prices for hardware like inverters have dropped 30 to 40 percent in the last 5 years. But, it’s the other parts, such as labor and project management that’s less flexible in price. They have less margin for decreasing costs.”

STANLEY[®]

Engineered Fastening

Sources

¹ “Market Data: Global Distributed Solar PV,” Navigant Consulting, 2017

² Seb Henbest, “Energy to 2040: Faster Shift to Clean, Dynamic, Distributed,” Bloomberg New Energy Finance, 2017

³ Anna Hirtenstein, “Wind Energy Feels the Force of World Markets,” Bloomberg Businessweek, 2017

STANLEY ENGINEERED FASTENING FAMILY OF BRANDS

AYDEL[®]

INTEGRA[®]

NELSON[®]

OPTIA[®]

POP[®]

STANLEY[®]
Assembly Technologies

TUCKER[®]