The Solar+ Decade &
American Renewable Energy Manufacturing

100 GW by 2030

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SEIA Solar Energy Industries Association®

www.seia.org

Introduction

SEIA has an ambitious goal – solar energy will constitute 20% of all U.S. electricity generation by 2030.[1] To reach this target, the massive growth the solar industry realized over the last decade will need to continue for the next decade. We will need to grow our industry an average rate of 18% annually and install more than 500 gigawatts ("GW") of solar projects by the end of 2030, including approximately 77 GW in 2030 alone. Achieving this goal will result in hundreds of thousands of new U.S. jobs, more than 14 million solar rooftops, and 500 million metric tons of avoided CO2 emissions. And although our industry has been slowed by the global pandemic, we still expect to meet the 20% by 2030 target.

To date, however, while the broader U.S. solar industry has and will continue to flourish, U.S. solar manufacturing has languished. It is time to seize the promise of American solar manufacturing. Consistent with the Solar+ Decade Roadmap's focus on aggressive collaboration, we must also ensure that the United States becomes a world leader in not only solar equipment but all renewable energy technologies, particularly including onshore and offshore wind and energy storage. In parallel with SEIA's goal of 20% solar energy by 2030, we are setting an additional Solar+ Decade target:

The Target

100 gigawatts of annual renewable energy manufacturing production capacity by the end of the Solar+ Decade[2]

This 100 GW target is designed to increase the United States' ability to supply not only domestic renewable energy projects but also export markets. The target also recognizes the benefits of an integrated global supply chain and an important role for imports. It is not intended to isolate U.S. renewable energy industries from the rest of the world, and we continue to recognize that tariffs are ineffective at incentivizing domestic manufacturing. In addition, the target takes into consideration the different growth potential and development stages for solar, wind, and energy storage manufacturing, with onshore wind being the most established to date.

Photo credit: PV Evolution Labs

[1] See *The Solar+ Decade 2020-2030: Roadmap for Building the Solar+ Economy*, available at https://www.seia.org/sites/default/files/2019-09/SEIA_Solar%2B_Decade_Roadmap_FINAL.pdf. Achieving this goal would put the U.S. within reach of achieving longer-term renewable energy goals such as 100% clean electricity by 2035.

[2] The Energy Storage Association has set a target of 100 GW of installed energy storage by 2030, see 100 x 30: Enabling the Clean Power Transformation, Energy Storage Association (August 2020), available at https://energystorage.org/wp/wp-content/uploads/2020/08/100x30-Empowering-Clean-Power-Transformation-ESA-Vision.pdf.

Solar Energy

The solar supply chain is diverse and starts with materials such as polysilicon, glass, polymers, steel, and aluminum. Primary finished components include solar panels, inverters, racking systems, and trackers, as well as solar thermal and concentrating solar power equipment and a host of other related products. In 2019, more than 35,000 Americans were employed in U.S. solar manufacturing facilities, most of which focus on the production of steel, racking systems, and trackers.[3] The United States currently has significant production capacity for polysilicon,[4] modest production capacity for solar panels,[5] encapsulants, backsheet, and inverters but no meaningful production capacity for ingots, wafers, cells, solar glass, machine tools, and many balance of system components. There is, thus, a tremendous opportunity to grow the U.S. solar manufacturing base across a broad category of products.

Wind Energy

In contrast to the U.S. solar manufacturing supply chain, the U.S. onshore wind industry has a relatively strong manufacturing base, though it also relies significantly on imports.[6] For wind projects recently installed in the United States, domestically-manufactured content is highest for nacelle assembly (>90%), towers (75-90%), and blades and hubs (50-70%), but is much lower (<20%) for most components internal to the nacelle.[7]

In addition, though still in its infancy relative to onshore wind, offshore wind equipment manufacturing provides significant growth potential.[8] Indeed, the U.S. offshore wind industry presents "a nearly $70 billion CAPEX opportunity in the offshore wind power supply chain over the next decade."[9]

[3] See *2019 National Solar Jobs Census*, The Solar Foundation, available at https://www.thesolarfoundation.org/national/

[4] There is approximately 70 kilotons of U.S. polysilicon capacity, sufficient for the production of more than 20 GW of solar modules annually.

[5] There is approximately 7 GW of U.S. solar panel assembly capacity. In contrast, annual U.S. solar panel consumption is expected to exceed 19 GW in 2020, an annual domestic solar panel supply shortfall of 12 GW, underscoring the importance of solar panel imports in the near-term.

[6] See 2018 Wind Technologies Market Report, U.S. Department of Energy, Office of Renewable Energy and Energy Efficiency ("*DOE Wind Technologies Report*"), p. 19, available at https://www.energy.gov/eere/wind/downloads/2018-wind-technologies-market-report. Wind turbine key components include blades, shafts, tower, gearbox, and generator, which together contain around 8,000 parts.

[7] Id

[8] See Stephanie A. McClellan, Ph.D., *Supply Chain Contracting Forecast for U.S. Offshore Wind Power*, Special Initiative on Offshore Wind, White Paper (March 2019) ("*Offshore Wind Power*"), p. 6, available at https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/10028/files/2020/01/SIOW-White-Paper-Supply-Chain-Contracting-Forecast-for-US-Offshore-Wind-Power-FINAL.pdf; Julian Jackson, *How to Develop the U.S. Supply Chain* (March 9, 2020), available at https://www.offshorewind.biz/2020/03/09/how-to-develop-the-us-supply-chain/

[9] See *Offshore Wind Power*.

Energy Storage

Energy storage is a game-changer for increasing grid-scale renewable energy integration and penetration. Because storage has the ability to capture energy for discharge at a later time, it can provide capacity, energy voltage and frequency regulation, fast ramping services, and load shifting, and stack those services with high precision. Storage will become indispensable to all players in the electricity sector – from the network operators who can call on storage providers to ease congestion and avoid capacity curtailment, to end users, who can make better use of the electricity they generate by consuming or injecting it on the grid when demand peaks cause prices to surge. Energy storage technologies include batteries, thermal storage, mechanical energy storage, hydropower, and hydrogen. Today, lithium-ion batteries are the predominant technology on the market.[10] According to Wood Mackenzie, "more than 99 percent of storage capacity installed in the third quarter of 2019 used lithium-ion batteries."[11]

The United States has an established and growing battery manufacturing base, with several facilities in place, including Tesla's 20 GWh per year Gigafactory Nevada, the highest volume battery plant in the world.[12] Additional plants are announced or under construction.[13] Domestic cell manufacturing is growing as well.[14] However, the domestic availability of key metals for batteries, including nickel, manganese, and cobalt, is limited.[15] Further, the domestic availability of key metals for batteries, including nickel, manganese, and cobalt, is limited.[14] Growing the domestic supply chain for lithium-ion batteries should therefore also include investments in mining, processing, and manufacturing.

The U.S. Department of Energy ("DOE") has recognized both the importance and challenge of building a domestic energy storage supply chain in a highly-competitive global market. In response, earlier this year, DOE announced the Energy Storage Grand Challenge, which sets goals for the United States to reach by 2030, including: (i) a comprehensive R&D portfolio; (ii) robust technology transfer ecosystem; (iii) best in class data and analytics; (iv) manufacturing and supply chain focused on new technologies, recyclability, and energy independence; and (v) a strong energy storage workforce.[16]

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[10] Lithium-ion batteries can incorporate a variety of materials that affect the voltage, discharge rate, and lifespan. The exact composition and manufacturing process for lithium-ion batteries varies depending on the end-use. At its core, however, a lithium-ion battery is comprised of four components: positive electrode ("anode"), negative electrode ("cathode"), electrolyte, and separator. The cathode stores and releases the lithium ions while the anode collects the ions and determines the capacity and voltage of the battery. An electrolyte facilitates the movement of lithium ions from the cathode to the anode. And the separator keeps apart the anode and cathode.

[11] Julian Spector, *What Would It Take for the U.S. to Become an Energy Storage Manufacturing Powerhouse?*, available at https://www.greentechmedia.com/articles/read/can-the-us-claim-dominance-in-energy-storage-manufacturing

[12] See *Tesla Gigafactory*, available at https://www.tesla.com/gigafactory

[13] See, e.g., Eileen Abbott, *New Battery Plant Planned for U.S.* (March 31, 2020), available at https://thehill.com/changing-america/sustainability/energy/490368-new-battery-plant-planned-for-us

[14] See, e.g., Tesla 10-Q (April 22, 2020), at pages 53-54, available at https://ir.tesla.com/static-files/bbc6e137-897a-4543-857a-59c5c2dbeadc

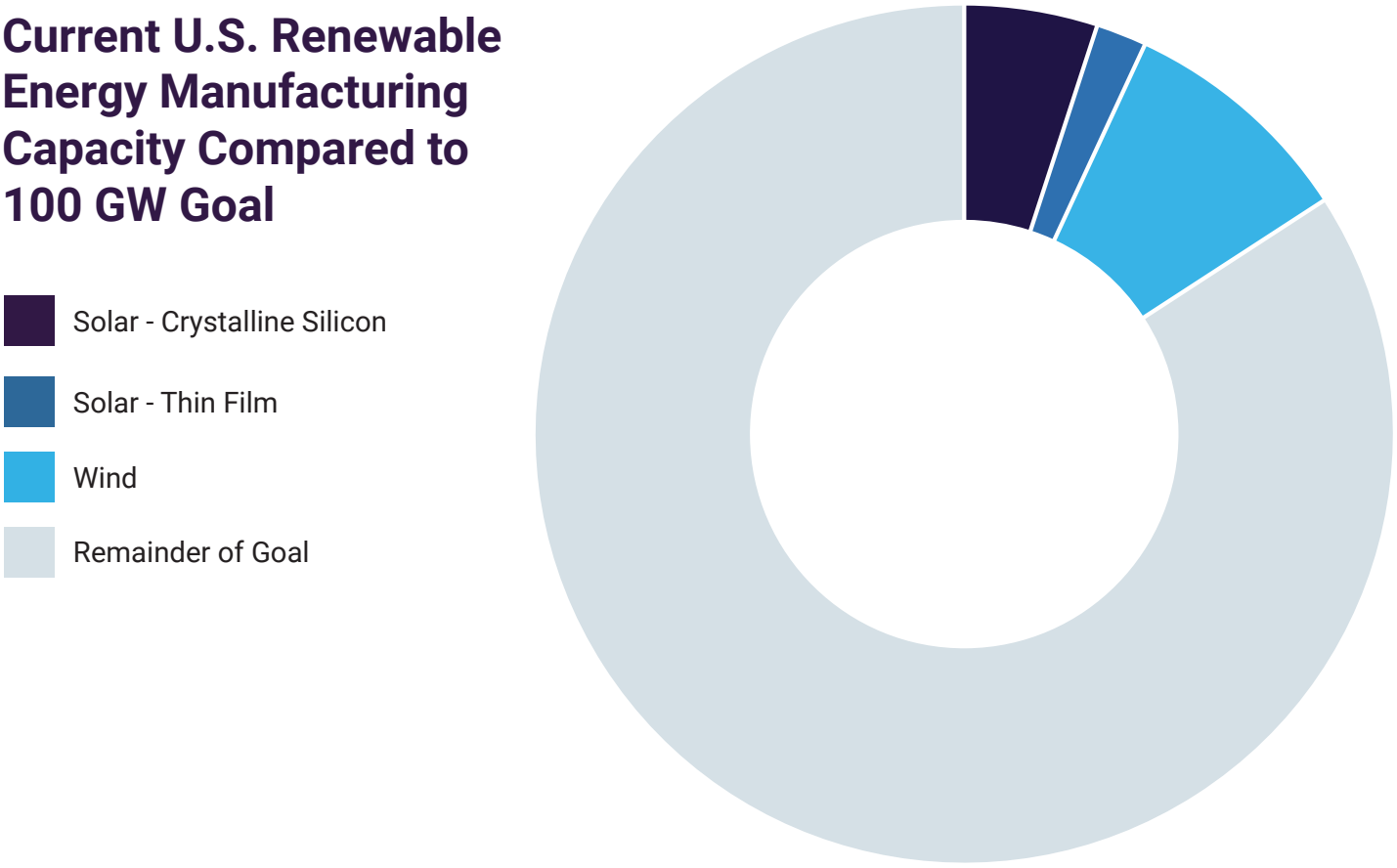
[15] See *Written Testimony of Simon Moores, Managing Director, Benchmark Mineral Intelligence*, available at https://www.energy.senate.gov/public/index.cfm/files/serve?File_id=9BAC3577-C7A4-4D6D-A5AA-33ACDB97C233

[16] See *U.S. Department of Energy Launches Energy Storage Grand Challenge*, U.S. Department of Energy (January 8, 2020), available at https://www.energy.gov/articles/us-department-energy-launches-energy-storage-grand-challenge. DOE also recently announced that it is "soliciting proposals from the National Laboratories and industry partners that pursue radical innovations for American battery manufacturing leadership." Energy Department to Fund National Laboratories to Establish Industry Partnerships for Battery Manufacturing Innovation, Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy (June 18, 2020), available at https://content.govdelivery.com/accounts/USEERE/bulletins/29176bc. DOE indicates that it "will directly fund the National Laboratories to establish public-private partnerships that solve engineering challenges for advanced battery materials and devices, with a focus on de-risking, scaling, and accelerating adoption of new technologies." Id. And on August 24, 2020, DOE announced the selection of 13 projects for battery manufacturing innovation, see Energy Department Selects National Laboratories to Establish Industry Partnerships for Battery Manufacturing Innovation, Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy (August 24, 2020) available at https://www.energy.gov/eere/articles/energy-department-selects-national-laboratories-establish-industry-partnerships.

Current U.S. Manufacturing Capacity

The United States needs to significantly expand its manufacturing investments to reach 100 GW of renewable manufacturing capacity. As of June 2020, U.S. polysilicon capacity exceeds 20 GW, but there is no active domestic production of ingots, wafers, or cells. The U.S. can assemble approximately 7 GW of solar panels per year, enough to meet roughly one-third of U.S. market demands today, though over half of that capacity came online in 2019.[17] Significant investment will be required across the supply chain in order to reach our 2030 target and ensure global competitiveness. Wind manufacturing capacities stand at 15 GW for nacelles, 9.2 GW for blades, and 8.9 GW for towers as of 2018.[18] And U.S. factories have recently made less than 2 GWh/year of lithium ion batteries for energy storage, though this number is expected to increase significantly in the near term.[19]

Current U.S. Renewable Energy Manufacturing Capacity Compared to 100 GW Goal



[17] First Solar, Hanwha Q CELLS, JinkoSolar, and LG opened module assembly facilities with a combined capacity of more than 4 GW.

[18] See *DOE 2018 Wind Technologies Market Report*, U.S. Department of Energy, Office of Renewable Energy and Energy Efficiency, p. viii, available at https://www.energy.gov/eere/wind/downloads/2018-wind-technologies-market-report

[19] Most of the energy storage manufactured in the U.S. is for electric vehicles. For example, Tesla's Gigawatt factory can manufacture up to 35 GWh per year, but the company only deployed 1.65 GWh for energy projects in 2019. See Tesla's 2019 SEC 10-K report, available at https://ir.tesla.com/node/20456/html

U.S. Renewable Energy Manufacturing & Economic Recovery

The COVID-19 crisis will have a lasting impact on the U.S. economy. But the crisis also presents opportunities for renewal and growth—to rebuild better. American renewable energy industries, and solar in particular, will help lead U.S. economic recovery given their unique ability to create high-paying jobs quickly and competitively.[20] As we move forward, however, we must ensure that the promise of American renewable energy manufacturing is not overlooked.

There are multiple benefits to growing domestic renewable energy manufacturing, including jobs, economic development, and promoting the United States' leadership in advanced technologies and innovation, as well as high-quality standards and conformity assessment programs. While manufacturing results in fewer direct jobs than the services sector, it has the highest jobs multiplier effect of any sector of the U.S. economy. "For every $1.00 spent in manufacturing, another $2.74 is added to the economy."[21] In addition, for "every one worker in manufacturing, there are another five employees hired elsewhere."[22]

Manufacturing investment also presents an opportunity for cost reduction. With some of the best research laboratories in the world, it will be essential to leverage existing U.S. R&D resources to advance these technologies. For example, National Laboratories offer testing facilities, technology transfer, and in-house experts to help manufacturers improve and commercialize their products. The United States must also continue to leverage its broader technology and innovation ecosystem, including regional and local incubators and the venture capital investment community.

A strong U.S. renewable energy manufacturing base and export competitiveness can also enable the United States to support its friends' and allies' development needs. Access to affordable, reliable electricity is key for improving health and economic development in developing nations.[23] In fact, the World Bank has recognized that renewable energy technologies "offer tremendous opportunity to deliver more service with a lower energy investment" to developing nations.[24]

Energy Security

Renewable energy industries will play an increasingly important role in ensuring U.S. energy independence and national security. Indeed, the U.S. Department of Homeland Security recently made clear that solar, wind, and energy storage are part of the nation's critical infrastructure.[25] And as demonstrated during the COVID-19 pandemic, it is important that the U.S. have a robust and resilient domestic supply chain for critical infrastructure equipment.

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[20] See Sonia Aggarwal and Mike O'Boyle, *Rewiring the U.S. for Economic Recovery ("Rewiring the U.S. for Economic Recovery")*, Energy Innovation Policy and Technology LLC (June 2020), available at https://energyinnovation.org/wp-content/uploads/2020/06/90-Clean-By-2035-Policy-Memo.pdf

[21] National Association of Manufacturers (NAM calculations using 2018 IMPLAN data), available at https://www.nam.org/facts-about-manufacturing/

[22] Id

[23] *Access to Energy is at the Heart of Development*, World Bank (April 18, 2018), available at https://www.worldbank.org/en/news/feature/2018/04/18/access-energy-sustainable-development-goal-7

[24] Id

[25] CISA Guidance on Essential Critical Infrastructure Workers, ver. 3.1, Cybersecurity & Infrastructure Security Agency, U.S. Department of Homeland Security (May 19, 2020), available at https://www.cisa.gov/sites/default/files/publications/Version_3.1_CISA_Guidance_on_Essential_

While U.S. renewable energy industries currently employ hundreds of thousands of Americans, the past decade has exposed the challenges U.S. manufacturers face from intense global competition and foreign government intervention in export markets. For example, U.S. polysilicon manufacturers face an existential crisis because there are no domestic customers for their products, i.e., ingot or wafer manufacturers, and U.S. polysilicon companies are effectively barred from selling into China, where nearly all ingot manufacturers are currently located. In contrast, in the absence of competition from the United States, Chinese polysilicon manufacturers greatly expanded their production capacity with the support of the Chinese government, thereby significantly improving their global competitiveness.

As solar and its sister industries increasingly become part of the backbone of the American economy, it is essential to the nation's continued economic health, global competitiveness, and energy security that we are not overly reliant on imports. We must put into place long-term incentives for supporting the growth of U.S. renewable energy manufacturing and encourage both U.S. and foreign manufacturers to invest in U.S. production capacity.

Carbon Reduction

Climate change is one of the defining issues of our time. We are entering a confluence of circumstances where climatic events that cause significant damages are influencing public opinion. These changing dynamics are leading to a greater emphasis on clean energy as a solution for reducing carbon emissions. As renewable, carbon-free resources, solar, wind, and energy storage are certainly part of any market or policy solution to address climate change.

Accounting for the cost of carbon in electricity generation provides an opportunity to enhance and accelerate renewable energy markets. The sooner we see carbon policies in place, the faster we pull forward renewable energy investment and deployment opportunities for the next decade. In this context, expanding U.S. renewable energy manufacturing will also help lower the carbon footprint of renewable energy equipment given shortened supply chains and the United States' cleaner energy mix relative to competing countries.

Federal Investments

As noted above, there are multiple benefits to growing U.S. renewable energy manufacturing, including the expansion of jobs, increased economic development, and helping to ensure the United States continues to be a technology leader. Renewable energy manufacturing, however, is an intensely competitive sector globally and overseas manufacturers are often aided by significant support from local and national governments, including direct subsidies and low-cost loans. If we hope to compete in this environment, the U.S. government must also invest in its manufacturers.

Federal investments must focus, first and foremost, on leveraging private sector investments. For example, the DOE Loan Programs Office's "estimated $39 billion loan and loan guarantee authority could leverage as much as $100 billion of private investments in innovative approaches to modernizing energy infrastructures across all energy sectors."[26] Federal investments must also be long-term in nature, in this case, over the course of a decade. In addition, these investments must include both supply and demand incentives. Indeed, without sufficient supply and demand certainty for domestic products, investment in manufacturing becomes too risky for investors in such a globally-competitive environment. As we have seen over the past decade, one without the other cannot sustain a strong U.S. renewable energy manufacturing base in the face intense global competition.

[26] *Rewiring the U.S. for Economic Recovery*, Energy Innovation Policy and Technology LLC (June 2020), available at https://energyinnovation.org/wp-content/uploads/2020/06/90-Clean-By-2035-Policy-Memo.pdf

To help further the discussion on incentivizing long-term investments in American renewable energy manufacturing capacity, we offer the following proposals:

Step change increase in renewable energy R&D funding

DOE's 17 National Laboratories are powerhouses of science and technology whose researchers tackle some of the world's toughest challenges. Significantly increased funding for these national institutions is necessary for regaining our overall renewable energy manufacturing edge and maintaining U.S. innovation leadership.

Long-term federal tax policies to support projects utilizing U.S.-manufactured equipment, materials, or components

This would both incentivize purchases of U.S. equipment while also offering long-term certainty to manufacturers.

Refundable tax credit for investments in U.S. manufacturing facilities

Tax credits are typically non-refundable and only useful to those with sufficient tax liability. Many manufacturers, especially new companies, may not have enough taxable income to utilize such a credit. This was one lesson from the Section 48C manufacturing tax credit program.

Loan guarantees

For every dollar loaned through the DOE's loan guarantee program, $2.50 of private investment went to the borrower. Loan guarantees effectively de-risk a project and increase investor comfort to finance burgeoning industries.

Low interest loans

In the private sector, low interest loans typically go to large businesses with high credit and an established relationship with the lender. This is one reason why the U.S. Small Business Administration ("SBA") had to set up a program to help small businesses access affordable loans under $5.5 million. Manufacturers, however, require much larger loans to achieve sufficient scale to effectively compete. Congress should establish a renewable energy version of the SBA's program that offers loans of up to $100 million.

Forgivable loans tied to job creation

This model was recently adopted in response to the COVID-19 crisis and has been effective for many companies.

Creation of a federal renewable energy bank

The availability of low-cost financing is a critical factor for achieving cost-competitive renewable energy manufacturing. A federal renewable energy bank would help secure low-cost capital for renewable energy manufacturers at favorable rates and terms.

Significantly expanded prize competitions, including grants and national lab use certificates

These prizes can significantly defray R&D expenses. Prizes could also take the form of favorable treatment in government procurement contracts.

Export loan guarantees competitive with foreign governments programs

U.S. exporters are increasingly at a disadvantage when competing with foreign suppliers given relatively generous foreign government export assistance programs.

Establish a rebate program for U.S. renewable energy equipment production

The intent here is to improve U.S. manufacturing competitiveness and incentivize demand for domestic solar producers. This program could also be tied to minimum efficiency and/or quality standards.

Help transition fossil fuel workers to solar

Establish a solar manufacturing specific program under the Economic Development Administration's Public Works Program. directed toward the loss of jobs in fossil fuel communities and/or opportunity zones.[27]

Direct the Department of Commerce to develop a National Renewable Energy Manufacturing Strategy

The roadmap would include industry specific chapters including solar, wind, and energy storage, as well as specific manufacturing targets for each segment.

SEIA's target of 100 GW of annual renewable energy manufacturing capacity by 2030 is not about picking winners or losers or favoring domestic products over imports. Rather, it is a recognition that a strong renewable energy manufacturing base is good for America's economic well-being – it supports the long-term health and safety of our country by enabling us to build critical infrastructure here at home.

[27] See e.g., *Assistance for Coal Communities (ACC)*, U.S. Economic Development Agency, U.S. Department of Commerce, available at https://www.eda.gov/coal/

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The Solar Energy Industries Association® (SEIA) is leading the transformation to a clean energy economy, creating the framework for solar to achieve 20% of U.S. electricity generation by 2030. SEIA works with its 1,000 member companies and other strategic partners to fight for policies that create jobs in every community and shape fair market rules that promote competition and the growth of reliable, low-cost solar power. Founded in 1974, SEIA is a national trade association building a comprehensive vision for the Solar+ Decade through research, education and advocacy.

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