

The Solar+ Decade **2020 - 2030**

Leading the Energy Transition



**Roadmap for Building
The Solar+ Economy**

September 2019



Energy Storage Codes & Standards
Land Use Workforce Development Diversity & Inclusion
Recycling & Sustainability **Climate Policy** Net Metering & Rate Design
Federal Tax Policy Cost Reduction
Energy Market Access

The Solar+ Decade

Grid Modernization Domestic Manufacturing **Open Competition**
Local Permitting International Trade
Consumer Protection Cybersecurity Transmission
Renewable Collaboration State RPS
Resilience Building Codes Solar + Storage
Electrification

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Executive Summary

This roadmap offers a vision for the radical transformation of the nation's energy system. It articulates where the solar industry stands today, sets the industry's goal for the next decade and outlines the steps we must take to get there. The pages that follow will explain how the solar industry will expand exponentially from comprising 2.4% of the U.S. electricity mix today to 20% of all U.S. electricity generation by 2030.

This is an ambitious but achievable goal. Critically, none of it will happen without a collaborative, well-funded effort led by a strong national trade association.

We have identified four significant pillars of our plan to reach 20% by 2030 through radical market transformation:

- We must work constructively with other industries and organizations that share our vision of radical market transformation. While our goal is predicated on solar penetration, we envision an electricity portfolio comprised of clean energy sources and technologies. Our ethos must be “**aggressive collaboration.**” We must be impactful and unabashed as we work with other stakeholders to advance storage, infrastructure, wind energy and any number of other technologies that will advance the solar vision and transform our markets.
- There are a number of **market accelerators** that can increase solar energy adoption. Capitalizing on these accelerators, including energy storage, carbon reduction goals and electrification, will be critical to meeting our 2030 goal.
- **Market levers and policy drivers** will play central roles in whether or not the solar industry reaches its destination. Climate policy, investment tax credit extension, state net energy metering, building codes and renewable portfolio standards all drive solar energy growth. Other factors include regional energy market rules, access to financing and opportunities to further reduce costs.
- Finally, and perhaps most importantly, we must **manage our growth.** Whether it is gaining a social license to operate by being good stewards of the land, proactively addressing recycling, modernizing the grid to allow for more solar deployment, protecting customers or ensuring a diverse customer base and workforce, we have to show that we are growing in a responsible way.

Why set this goal of 20% by 2030 and articulate a vision of radical market transformation? Because, when we achieve this goal, we will have generated hundreds of billions of dollars in investment and created hundreds of thousands of American jobs. We will reduce carbon emissions by hundreds of millions of tons, replacing more than 150 polluting power plants. And, when done with intentionality, we will grow prosperity for all Americans by creating economic opportunity and clean abundant electricity for our communities.

Throughout this report, we outline actionable steps that must be undertaken to realize the 20% goal. Key actions include:

Short-term (one to two years)

- Extend the Solar Investment Tax Credit.
- Reduce trade barriers
- Expand on state-level coordination with partners to strategically plan nation-wide solar advocacy.

- Strengthen trade association technical capacity and resources to further engage in regulatory proceedings, including FERC, RTO/ISO and state bodies.
- Develop shared policy priorities in the pan-renewable space.
- Begin crafting policy priorities for carbon legislation that will provide certainty and maximize opportunity for the solar industry.

Mid-term (three to five years)

- Be the voice of clean technology in the climate policy debate, including crafting carbon legislative priorities that will maximize opportunities for solar.
- Achieve adoption of SolarAPP.
- Position solar + storage as the marginal generation resource (i.e., the best, cheapest and most capable) in state and utility resource planning and procurement.
- Build a self-sustaining, nationwide PV Recycling Network.
- Build a workforce that better reflects our country.
- Expand the U.S. solar supply chain and build out both new and underutilized solar technologies, including photovoltaic (PV), solar heating and cooling and concentrating solar power technologies.
- Create a vision for longer-term financing mechanisms.

Long-term (five years and beyond)

- Fully-fund a 50-state policy strategy.
- Build new transmission to support solar growth, including lines that provide regional and system-wide renewable energy and reliability benefits.
- Work to build solar powered infrastructure that serves as a national network supporting the full electrification of the transportation sector.
- Establish a sophisticated, locally-driven solar engagement plan to support solar expansion.

SEIA is well positioned to lead this radical transformation and be the lynchpin for the aggressive collaboration that is needed. However, the solar industry writ large will need to actively engage on all of the areas identified in this roadmap. It will be a transformative and prosperous journey for those in the solar industry today, and the thousands of new companies and hundreds of thousands of workers who will join us on the road ahead.



Introduction

The Vision

In May 2019, SEIA convened 100 leaders from across the solar and solar + storage industry to build a long-term vision for the solar industry and the nation's energy infrastructure. SEIA articulated an ambitious goal of radical market transformation, including branding the 2020s the Solar+ Decade and solar + storage **reaching 20% of electricity generation in the U.S.**

After agreeing that the 20% by 2030 goal was ambitious but achievable, the group mapped out specifically how to achieve this goal and what barriers we must start addressing today. We concluded that if we work collaboratively, across the industry and the energy sector, and invest the time, energy and resources to follow this roadmap, the vision of the Solar+ Decade will be realized.

In the last decade, the solar industry experienced an average annual growth rate of more than 50%. Installed solar capacity now exceeds 69 GW, which supplies more than 2% of U.S. annual electricity generation and includes more than 2 million systems, compared to less than 2 GW and about 100,000 systems at the end of 2009.

Today, the industry generates \$17 billion in annual revenue and, at the end of 2018, employed 242,000 individuals. The solar industry has reached these impressive numbers without tapping our full potential on lowering costs and opening new state markets.

Solar will continue to grow at a moderate pace thanks to its increasing cost-competitiveness. But meeting climate goals and hitting 20% of generation by 2030 will require deliberate policy and industry action.

Our ambitions involve nothing less than a **radical transformation of the U.S. energy sector fueled by the dramatic growth of solar + storage**, both of which will be leading technologies in our broader clean energy future.

As we look to the 2020s, the energy economy is poised for a paradigm shift. Solar offers a solution to some of our most pressing climate challenges and will play the primary role in America's new energy mix. This industry roadmap serves as a galvanizing force, to align us in our shared vision for the next decade and set forth a clear path to overcome barriers and make the most of all the opportunities before us.

Figure 1: Solar Share of U.S. Electricity Generation, 2018 - 2030

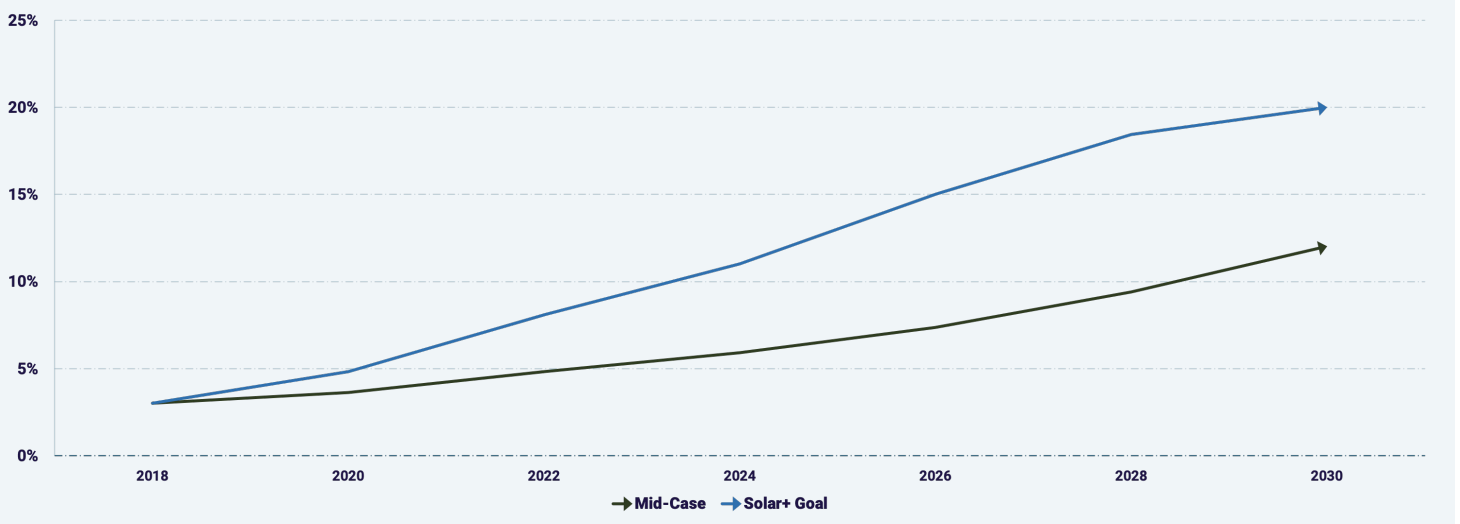
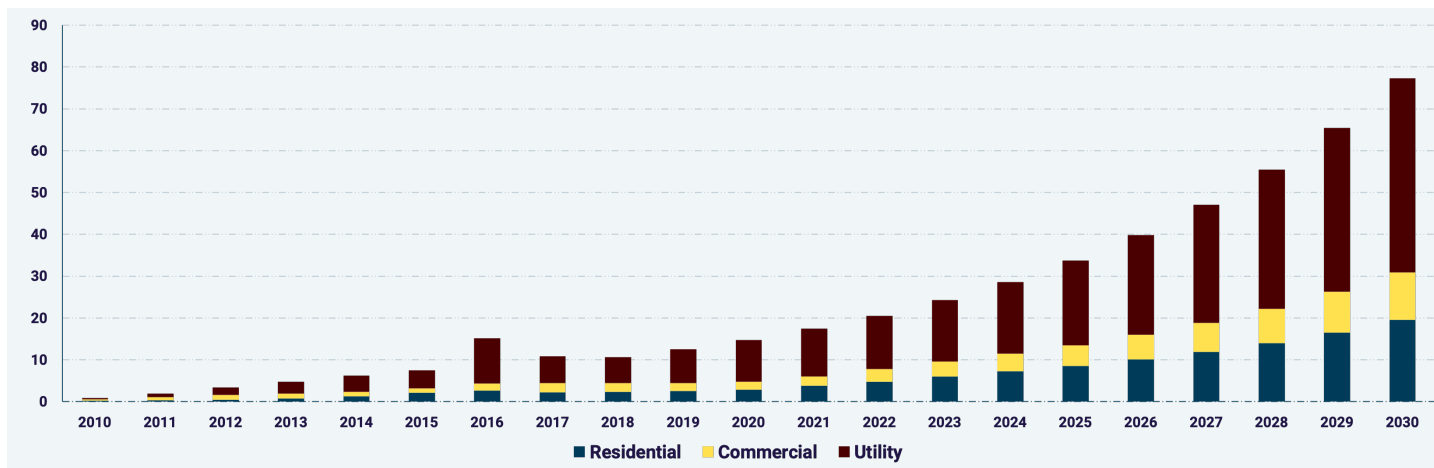


Figure 2: Annual Solar Installations (GW) Required to Reach 20% of Generation by 2030



What 20% by 2030 will look like:

- Solar will represent the largest source of new power generation added annually.
- **500 GW of PV will be installed by the end of 2030**, including approximately 77 GW in 2030 alone.
- \$345 billion will be invested in solar development over the next ten years, reaching \$53 billion annually.
- Solar installations will grow annually by roughly 18% over the next ten years.
- Solar will be installed on more than **14 million rooftops** by 2030.
- Solar will employ a growing workforce of 600,000 individuals. The workforce and the consumers that these workers serve will **reflect the diversity of our nation**.
- Solar will be responsible for a reduction of over **500 million metric tons of greenhouse gas (GHG) emissions** annually by 2030, or roughly 35 percent of all electric sector GHG emissions.
- Solar would provide enough electricity to replace 150 coal power plants and, in the southwest, CSP with thermal energy storage and PV would provide electricity and grid services around the clock.
- Increases in solar deployment will have an even greater impact as the industry joins a collaborative effort toward the “**electrification of everything**.”
- Solar growth will be supported by a **domestic manufacturing base** and strong U.S. supply chain.

- Solar will **enhance America’s energy and national security** through diversification of energy resources, strengthening our energy infrastructure, providing resiliency to the grid, powering military bases and other means.

What It Will Take

To reach our 20% by 2030 goal, the industry will need to unabashedly pursue policies to facilitate solar deployment and aggressively collaborate with other technologies and stakeholders to make it happen. It is incumbent upon SEIA and our allies to create a shared clean energy vision. Together, we will write a new story for U.S. energy in the 2020s.

Meeting this target will require more than just public appetite for solar. Costs will need to decline across all market segments by nearly 50 percent and deployment will need to pick up substantially each year. Solar will also need to replace retiring capacity, primarily coal and increasingly older natural gas units, over the course of the decade. And as we increase our market share of both existing and new load, we will face external headwinds from well-funded and powerful competition.

SEIA must take bold steps over the next couple of years to put solar on the trajectory to meeting ambitious goals for U.S. energy generation. While it will not be easy, it is up to us to shape our future and create a new story for solar in the United States.

Our first step into the Solar+ Decade starts now.

Collaboration

Achieving the 20% by 2030 goal will require, first and foremost, an unparalleled level of cooperation within the solar industry. Each sector brings unique benefits and plays an important role in meeting our ambitious goal and providing public and political support.

We cannot afford to pass up opportunities and it is essential that the separate segments of our industry contemplate and work towards a future where all sectors of the industry prosper. We need to combine our resources and our message for each of our market segments to achieve sustained growth. SEIA must continue to serve as the convening power of the industry and will aggressively foster collaboration among various industry segments.

In addition to increased coordination within the solar industry, achieving the Solar+ Vision will require aggressive collaboration across the clean energy space. We must collaborate closely with the wind and storage industries and related technologies to create a comprehensive renewable mindset in this country. We need to work with others to get additional infrastructure and electrification of transportation. We must expand our list of allies, while working cohesively as an industry to fend off well-funded challenges from fossil fuel and other sources that are moving toward obsolescence.

Many utilities are embracing clean energy, and solar in particular. Moving forward, it will be important to develop solutions that benefit both utilities and solar companies. To reach a clean, reliable and secure grid, utility business models must transition to better align with these goals.

As the industry has matured, we are also seeing greater investments from incumbent energy producers in the solar space. The Solar+ Decade will afford us the opportunity to partner with other major players in the energy industry.

The solar industry must also expand its collaboration with climate advocates and corporate and institutional buyers, including

state and federal governments and colleges and universities, who are helping lead the way towards a solar+ future. It is equally important that we look for new allies and supporters of solar energy, including conservative partners and rural economic development organizations – the economic benefits of solar energy have no party affiliation.

"Energy storage brings flexibility to all clean resources for a more resilient, efficient, sustainable and affordable grid. We can achieve so much more by working together and promoting holistic solutions to America's energy challenges."

Kelly Speakes-Backman
Chief Executive Officer
Energy Storage Association

"One of the key strengths of solar, and clean energy more broadly, is our numbers. When taken together, we represent hundreds of thousands of jobs, millions of customers, and billions in private investment. But we can only take advantage of these strengths if we work together and present a unified voice to policymakers. As we enter this critical phase of growth, industry collaboration is more important than ever."

Tom Starrs
Vice President, Market Strategy & Policy
SunPower

"Solar energy, especially when paired with storage, empowers American homeowners and consumers. Giving people control over their electricity is a powerful tool, one that increases resilience and reliability for the electric grid. We need to continue driving distributed solar forward to provide Americans with the energy freedom they deserve."

Anne Hoskins
Chief Policy Officer
Sunrun

"Green Mountain Power is determined that through innovation, collaboration and grit, we can make remarkable strides and be the example of the change we want to see and deliver this energy future to benefit the customers we serve."

Mary Powell
President & CEO
Green Mountain Power

Next Steps

- Practice aggressive collaboration by expanding partnerships with advocacy groups across the energy landscape in the pan-renewable space and look for ways to increase efficiency including shared legislative priorities. SEIA+partners. (short-term)
- Formalize state-level coordination with partners to plan nationwide build out. SEIA-led. (mid-term)
- Expand existing relationships and create new partnerships with climate advocates, corporate buyers, utility groups, conservative organizations, and rural economic development organizations. SEIA-led (mid-term)
- Work with partners to develop proposed solutions for new utility business models. Develop alternative revenue streams for utilities as distributed energy sources increase and the need for additional wires and substations decrease in some areas. SEIA+partners. (mid-term)



Photo Courtesy of Amazon.com, Inc.

Market Accelerators

There are economic and political dynamics that present a major opportunity to accelerate our growth beyond the solar industry. Reaching the 20% goal will require taking advantage of these accelerators. This section focuses on the three market dynamics with the biggest potential to increase solar deployment in the short and long term: energy storage, carbon policy and electrification.

Energy Storage

Arguably, no other enabling technology will play a more important role in the exponential growth of solar than energy storage. The scaling of energy storage technology, including battery technology, thermal energy storage, pumped hydro and seasonal storage capabilities, is a necessary precursor to solar reaching its full potential.

Solar and storage create business opportunities for each other. As solar penetration increases, utilities and solar companies are turning to storage. Energy storage can smooth electricity prices through arbitrage, manage evening energy ramps, mitigate curtailment risk, provide black start capability, provide backup power and more. For distributed projects, storage can help customers manage the move toward time-of-use (TOU) pricing and later TOU periods, and give system owners access to the power from their solar panels for more hours of the day.

The cost of lithium ion batteries has fallen by 85% over the last 8 years¹ as manufacturing has scaled up to support both electric grid applications and electric vehicles. Concentrating solar power

paired with thermal storage could also see increased adoption. Thermal energy storage is a well-established, low-cost energy storage solution available for rapid adoption today. Thermal storage also presents opportunities for technological advancements, including adaptation to stand-alone grid storage, as longer duration grid storage technologies such as pumped hydro scale and enter the market.

Most solar companies view storage as a significant growth opportunity. While there is plenty of room for growth of stand-alone solar in most states, the long-term success of the solar industry and its ability to scale to 20% of total energy generation and beyond depends on the cost-effective integration of storage.

Solar + storage is increasingly cost-effective today.² A recent report found that Clean Energy Portfolios incorporating solar + storage “are lower cost than 90 percent of proposed gas-fired generation at the proposed plant’s in-service date.” Our job will include effectively communicating accurate costs and capabilities of solar + storage to regulators, utilities and other energy buyers, to position solar + storage as the “go-to” resource, today.

Next Steps

- ☐ Expand the Investment Tax Credit (ITC) for storage. SEIA+partners (short-term)
- ☐ Establish Integrated Resource Plans that incorporate solar + storage as a cost-effective alternative to fossil fuel power plants. SEIA+partners (short-term)
- ☐ Promote and establish effective, costed-out, solar + storage rate design. SEIA+partners (short-term)
- ☐ Advocate for codes and standards that permit quality and cost-effective storage installation and construction. SEIA-led (short-term)
- ☐ Establish and influence quality-oriented operations and maintenance activities such as developing guidelines for solar and storage equipment. SEIA-led (short-term)
- ☐ Improve, simplify and streamline interconnection for storage and hybrid solar + storage projects. SEIA-led (short-term)
- ☐ Create additional public-private investments to make storage affordable and applicable across a broader range of projects. Industry (mid-term)
- ☐ Enable storage value stacking in wholesale and retail markets. SEIA+partners (mid-term)

¹BNEF “2019 Long Term Energy Storage Outlook”

²The Growing Market for Clean Energy Portfolios (RMI 2019), <https://rmi.org/insight/clean-energy-portfolios-pipelines-and-plants/>

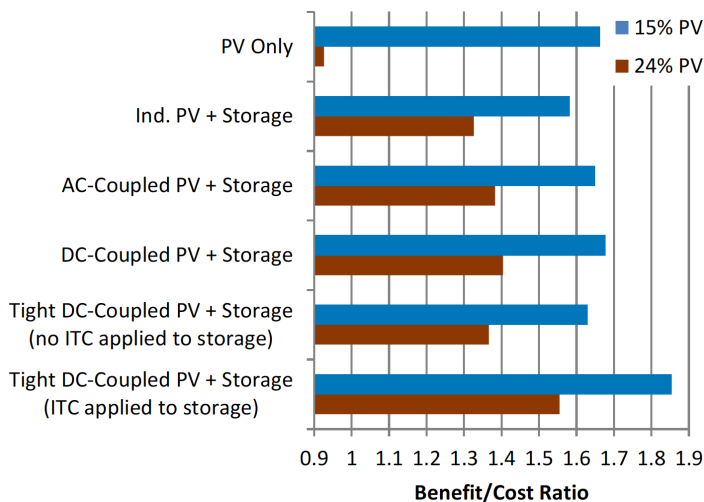


Figure 3: Benefit/Cost Ratio for solar and solar + storage at different levels of penetration
(Source: NREL)³

leaving a better world for future generations polled as the most convincing arguments to invest in solar energy.⁴

Based on existing market forces alone, solar deployment is on an upward trajectory. We have successfully built an industry on a message of job creation and economic growth. As a renewable, carbon-free resource, however, we are also 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 the solar market. The sooner we see carbon policies put in place, the faster we pull forward solar investment and deployment opportunities for the next decade.

While reaching 20% will help significantly reduce CO₂ emissions by 2030, it will not alone address IPCC-identified reduction targets. To see global reductions by 50%, a much broader coalition will need to work together to create an economy-wide solution, of which solar will be a critical piece.



Photo Courtesy of Brightsource Energy, Inc.

Carbon Reduction

Climate change is one of the defining issues of our time. We are entering a confluence of circumstances where climactic 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.

According to the Intergovernmental Panel on Climate Change (IPCC), in order to limit the planet to 2 degrees Celsius of warming above pre-industrial levels, we must globally reach 50% emissions reductions by 2038.

Addressing climate change is becoming an increasing priority for many voters. In a recent CNN poll⁵, 96% of registered Democrats ranked “taking aggressive action to slow the effects of climate change” as very or somewhat important (82% very, 14% somewhat). Support for clean energy transcends party politics as well. In a 2018 survey, 74% of GOP voters felt the government should be doing more to encourage solar energy deployment. The health and environmental benefits of solar are a major driver of this public support; messages about toxic pollution and

Next Steps

- ☐ Be the voice of clean technology in the climate policy debate, including in crafting carbon legislative priorities that will maximize opportunities for solar. SEIA-led (mid-term)
- ☐ Collaborate with a broad advocacy coalition that develops a credible climate solution with a prominent role for renewables SEIA+partners (mid-term)

³Evaluating the Technical and Economic Performance of PV Plus Storage Power Plants (NREL 2017), <https://www.nrel.gov/docs/fy17osti/68737.pdf>

⁴<https://www.cnn.com/2019/08/19/politics/cnn-climate-crisis-town-hall/index.html>

⁵SEIA Solar Messaging Survey 2018, <https://www.seia.org/sites/default/files/2018-09/SEIA-GSG-Solar-Messaging-Survey-2018.pdf>

Electrification of Everything

Widespread electrification of the U.S. economy, particularly in the transportation sector, is another major accelerator for the solar industry. As electricity demand increases, a growing combination of wind, storage and solar technologies can help meet this demand while addressing peak load challenges, ramping and other strains on the electric grid.

Electrification of the transportation sector, which makes up the largest share of U.S. emissions, will require upgrades to our power grid, ubiquitous charging stations and affordable and clean energy options across the full range of geographies and social demographics. Estimates for mass EV adoptions vary but are expected to dramatically increase over the next decade. Bloomberg New Energy Finance expects that by 2040, 57% of all passenger vehicle sales will be electric. In total, EVs may add 11% to total U.S. electricity consumption in 2040.

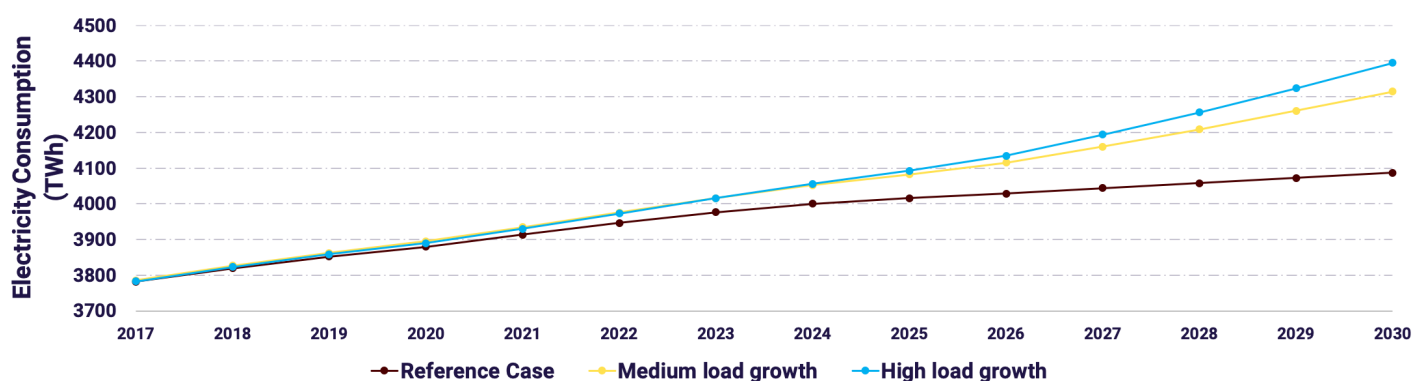
For residential and commercial buildings, space and water heating and cooling generate more than 560 million tons of carbon dioxide each

year – one-tenth of annual U.S. emissions.⁶ But now, we have the opportunity to meet nearly all our buildings' energy needs with onsite energy generation and storage from an increasingly low-carbon electric grid.

According to the National Renewable Energy Laboratory's (NREL) Electrification Futures Study, economy-wide electrification could deliver sustained electricity demand growth. The report found that U.S. electricity consumption could increase by 20 percent under the medium scenario and by 38 percent under the high scenario compared to the reference case. To realize any substantial reduction in emissions requires utilization of solar, storage and other renewable resources.

Increased electrification can also help address variabilities in solar supply through a variety of ways, including dispatchable load (i.e., power consumption that can be scheduled, drawing more energy in times of peak production and then releasing clean power back to the grid during the valleys). As the transition to electrifying more of the economy continues, solar's value in providing clean, low-cost energy will only increase.

Figure 4: NREL Electrification Futures Scenarios



Next Steps

- ☐ Support electrification efforts of allies and ensure that policymakers know solar is ready to supply the lowest-cost source of generation to meet growing load. SEIA+partners (mid-term)
- ☐ Ensuring that solar and solar + storage technologies are selected in utility resource planning exercises, e.g., by demonstrating costs and capabilities accurately. SEIA+partners (mid-term)
- ☐ Develop properly designed rules and regulatory incentives to provide clean electrification opportunities to utilities and their customers. SEIA+partners (mid-term)
- ☐ oWork to build solar powered infrastructure that serves as a national network supporting the full electrification of the transportation sector. SEIA+partners (mid- to long-term)

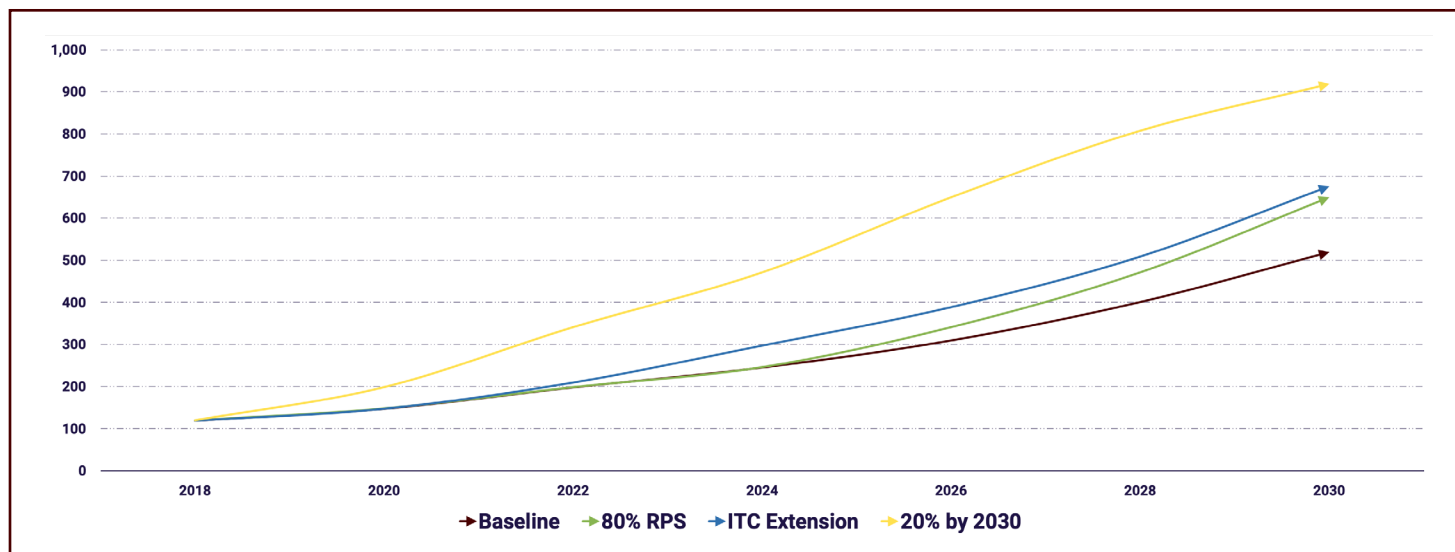
⁶RMI, "Electrifying Buildings for Decarbonization" <https://rmi.org/report-release-electrifying-buildings-for-decarbonization/>

Market Levers & Policy Drivers

There are a variety of internal and external factors with the potential to dramatically increase, or limit, solar deployment over the next decade. Our success in reaching the solar+ goal will depend on effectively managing and navigating these levers.

For some, direct advocacy for public policy outcomes will be the necessary path forward. In others, the industry will need to develop new business paradigms to adapt to changing technologies and market structures. The 20% goal is not achievable under business-as-usual growth projections. To put the industry on a path to deeper levels of penetration, we must drive down costs, develop new financing mechanisms and build stronger federal and state policy.

Figure 5: U.S. Solar Generation (GWh) Across Policy Scenarios & Targets



Cost Reductions & New Value Opportunities

Cost reductions for equipment and services are pivotal to the Solar+ Decade and serve as both market accelerators and market levers and policy drivers. Our ability to dramatically increase generation depends on cost competitiveness. Equipment efficiency gains, soft cost reductions, lower transmission and distribution costs, scaling of manufacturing and innovative financial mechanisms will be essential to continue to drive down solar's overall costs.

While the cost of residential solar installations has decreased more than 70% over the last ten years, costs are still much higher in the United States than in other mature markets, largely due to non-hardware "soft costs." The direct and indirect costs of permitting, inspection and interconnection can add about \$1 per Watt, or \$7,000, to the cost of a typical residential system.

Nationwide, there are over 15,000 authorities having jurisdiction (AHJs) with distinct permitting and inspection requirements, application costs and approval times. A team of industry leaders, including the U.S. Energy Information Administration and its reporting companies, the Solar Foundation and the National Renewable Energy Laboratory are working with stakeholders representing building officials on a platform called Solar Automated Permit Processing (SolarAPP). This platform will provide a streamlined process to increase efficiency and reduce the time and cost of a solar permit, leading in turn to lower cancellation rates and overall system costs.

SolarAPP will also benefit local governments, which face budget constraints and growing workloads to keep up with the accelerated pace of solar energy development. Automated permitting will reduce time spent and increase permit revenues, allowing AHJs to focus their resources on post-installation and inspections.

In addition to permitting, building codes and installation/product safety standards have the potential to hinder or accelerate the growth of solar, and our success in deploying residential and commercial systems at scale will rely on sustained engagement with key stakeholders such as the National Fire Protection Association (NFPA), International Code Council (ICC), American Society of Civil Engineers (ASCE), Underwriters Laboratories (UL) and other bodies. In light of the recent PV mandate for new low-rise construction in California, and efforts nationwide to focus on decarbonization of buildings, integrating solar into relevant codes and standards has enormous potential for growth, and can help drive down costs across markets.

Manufacturing 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 solar technologies. For example, NREL developed the Concentrating Solar Power Gen3 Demonstration Roadmap to address and prioritize research and development gaps for CSP technology. In addition, while the cost of electricity from CSP plants has decreased 46% from 2010 to 2018, additional cost reduction will come from continued deployment and technology evolution.⁷ It will also be important to significantly expand the solar industry's own research capabilities to identify new solutions for accelerating the deployment of solar technologies.

Next Steps

- ☐ Leverage federal R&D resources to advance solar technologies. SEIA+partners (short-term)
- ☐ Achieve rapid development and adoption of SolarAPP. SEIA-led (mid-term)
- ☐ Accelerate the adoption of new solar technologies. Industry-led (mid-term)
- ☐ Identify new revenue streams for solar industry research organizations. SEIA+partners (mid-term)
- ☐ Ensure continued development of solar-friendly requirements via engagement with codes and standards development organizations such as NFPA, ICC, ASCE, UL, NIST, among others. SEIA+partners (mid-term)

Finance & Tax

Generating the necessary investments to support 500 GW of installed capacity (equivalent to 860,000 GWh of generation annually) by 2030 is a significant challenge. As the market matures and grows, our revenue streams and contract structures also need to evolve.

We need to expand our access to capital. This could be through industry outreach and collaboration with potential sources of investment and credit enhancement, including real estate investors and asset managers, capital markets, insurance, foundations, retail banks, specialty finance and various other stakeholder communities.

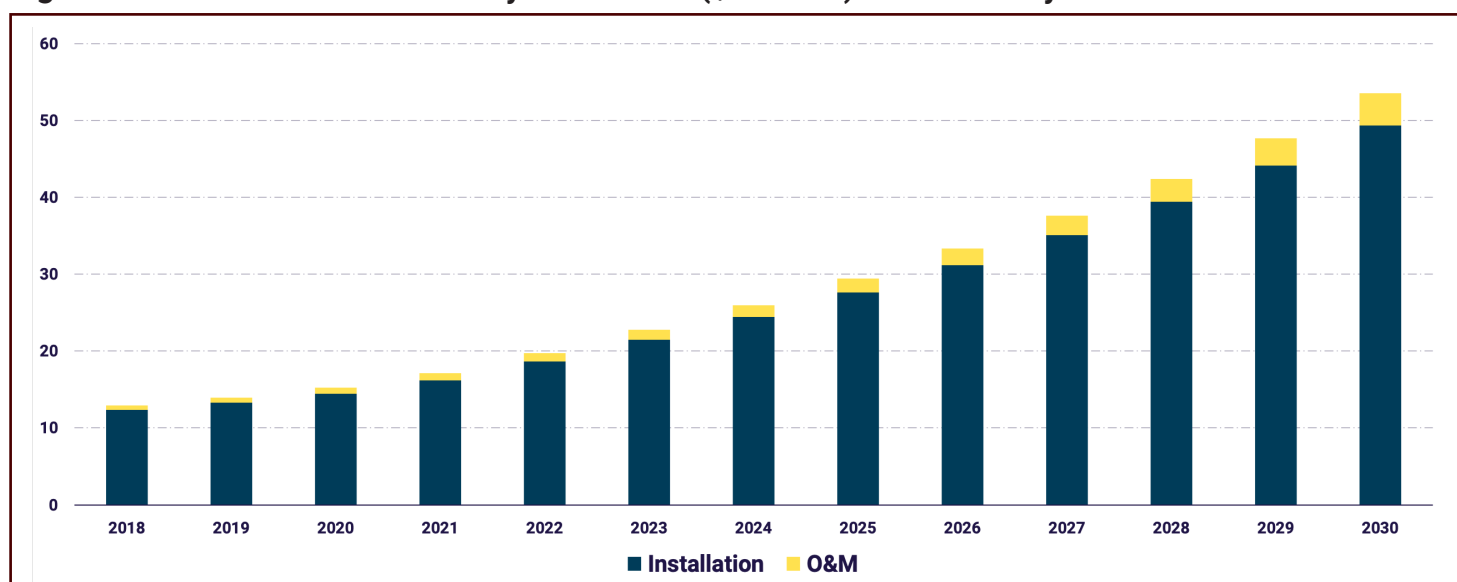
The industry also will need to focus on financial innovations designed to leverage available credit enhancement and pool solar project cash flows for low-cost debt investment by pension

funds and other large-scale capital managers. In addition, the industry must find ways to open untapped commercial markets, including multi-tenant retail, office and low-moderate income housing sectors for wide-scale solar deployment.

In the short term, the ITC continues to push extensive growth in the market and puts us in a better position to hit 20%. Since the ITC was enacted in 2006, the U.S. solar industry has grown by more than 10,000%. With an ITC extension, we can generate an additional \$87 billion in private investment and 82 GW of generating capacity.

Moving forward, a tax policy that provides stability and investment opportunity for solar energy should be a part of any national discussion about climate change, infrastructure or decarbonization. Over the next decade, we must work with policymakers and a broader policy community to ensure that any wholesale changes to the tax code account for solar's true value.

⁷IRENA, Renewable Power Generation Costs in 2018, <https://www.irena.org/publications/2019/May/Renewable-power-generation-costs-in-2018>

Figure 6: Annual U.S. Solar Industry Investment (\$ Billions) Under 20% by 2030 Scenario

Next Steps

- ☐ Extend the Solar Investment Tax Credit (ITC). SEIA-led (short-term)
- ☐ Broaden number of interested pension funds and large institutional investors through educating on solar investment opportunities. Industry-led (short-term)
- ☐ Create partnerships with national finance community advocacy groups. SEIA+partners (mid-term)
- ☐ Create a vision for longer term funding mechanisms. Industry-led (mid-term)

State Strategy

To see transformative changes in the next decade, the solar industry needs a fully coordinated, sophisticated, well-funded and economic-driven state advocacy strategy. Our approach to date, which has successfully grown the solar industry to where it is today, is to create and maintain a balance among defending and maintaining existing markets and taking steps, often with partners, to support the creation and extension of new markets. When deciding which states to invest resources in, we look for legislative and regulatory opportunities and challenges, interest of the solar industry and interest of partner organizations.

Though federal policy (i.e., the ITC) serves as a foundation for solar's growth across the nation, the disparity in state installations can be tied directly to state level policies, from California with over 25,000 MW to North Dakota with virtually none. Where state policy supports renewables – through Renewable Portfolio Standards, Net Metering and the like – solar

deployment is high and growing. In other states, without policy support, solar deployment lags, or proceeds in fits and starts. Exceptions are few and far between.

The resources the solar industry dedicates to pro-solar market reform do not match our ambitions. While policymakers are generally supportive of solar energy, the solar industry often faces better-funded opposition from incumbent interests. As one former regulator has said, “utilities treat regulatory affairs as a profit center. The solar industry treats it as a cost center.”

Over the course of the next decade the industry must not only continue to prioritize top solar states, it must also expand and evolve its advocacy in several ways. Preserving established markets, which provide industry certainty and a substantial number of GWs, will continue to be a key priority for the solar industry and SEIA. At the same time, we must continue to expand our advocacy beyond the dozen states that have traditionally led solar markets, focusing on the states with the most opportunity for solar deployment, investment and job growth.

For instance, we must ensure that solar + storage replaces retiring coal capacity in the Midwest, where the capacity replacement values will be highest in states like Ohio and Indiana. And we must ensure that solar + storage captures the

majority of load growth, which is expected to be higher in Southeast states including Louisiana, Georgia and Tennessee. We will use these factors to determine potential “additionality” and solar investment potential.

Table 1: State Rankings Across Key Indicators for Solar+ Decade Prioritization

(shading for each state reflects the number of lists in which it ranks in the top 10)

Sources: EIA, LBNL, NREL

Top 10 States by load growth through 2030	Top 10 states by existing capacity retirements through 2030	Top 10 states by load growth plus capacity retirements through 2030	Top 10 states by total RPS requirements in 2030	Top 10 states by rooftop solar potential
Texas	Texas	Texas	California	Texas
Florida	Ohio	Arizona	New York	California
Louisiana	Indiana	Indiana	New Jersey	Florida
Georgia	Pennsylvania	Florida	Illinois	New York
North Carolina	Illinois	Minnesota	Maryland	Illinois
Tennessee	Kentucky	Ohio	Pennsylvania	Ohio
Arizona	West Virginia	Kentucky	Minnesota	Georgia
Kentucky	Georgia	Louisiana	Nevada	North Carolina
Ohio	North Carolina	Georgia	Massachusetts	Michigan
Alabama	Michigan	North Carolina	Texas	Arizona

We must also evolve our advocacy beyond the traditional policy toolkit, both acknowledging renewables’ superior economic position versus traditional resources and to successfully work in states that have been less hospitable to policy in the past. As we have seen in South Carolina, where we successfully implemented pro-solar policies in a state with a Republican-led state legislature and governor, we are evolving beyond the methods of solar’s early days.

For instance, future solar growth will require SEIA to invest in utility resource planning efforts. These are the fora in which load growth due to electrification will be quantified, where system planning to replace retiring coal facilities will take place and where we must demonstrate the capabilities of modern solar + storage facilities to meet reliability needs.

Future growth as envisioned here will also require investment in distribution resource planning, to maximize development of load flexibility that will accommodate more

renewables and to ensure that compensation is provided to all of the services that distributed energy resources (DERs) can provide. It will require carefully engaging with policymakers to develop sustainable approaches to distributed solar compensation as penetration grows.

The community solar model will be a key driver for increased deployment and equitable access in the Solar+ Decade. Community solar can help provide all Americans equal access to the economic and environmental benefits of solar energy generation regardless of the physical attributes or ownership of their home or business. As much as 3.5 GW of community solar are expected to come online over the next five years.⁸ Finally, part of expanding our toolkit will entail establishing stronger relationships with corporate and institutional buyers of renewables, leveraging their power in state capitals and working to ensure that they can obtain the renewables that they demand.

⁸SEIA/Wood Mackenzie Power & Renewables U.S. Solar Market Insight Report 2019 Q3

In addition, as solar penetration increases and solar becomes more mainstream, the issues and challenges that we face are changing. For instance:

- For the states/regions with less than 1% penetration, we can use the traditional policy toolkit, talk about best practices in Net Metering, rate design, procurement policy, economic benefits, etc. and how to kickstart markets that have been lagging.
- Moving from <1% to 5% requires addressing scaling concerns – interconnection, distribution planning, wholesale market access and shifting from basic to more sophisticated state policies (e.g., MA SMART, TOU rates).
- Going from 5% to 10% starts to push harder into reliability, RTO expansion, transmission planning, displacing existing capacity, integrating longer-term energy storage, dynamic load control and integrating EVs and other DERs, and moving to constructs such as net billing.
- Growing beyond 10% starts to broach topics such as seasonal energy storage, synthetic biogas production, inter-RTO coordination and enabling load flexibility.

As the issues facing a growing solar + storage industry evolve, the utility industry must also change. States like Hawaii have begun to experiment with performance-based regulation

(PBR), to better align utility incentives with policymakers' goals. A well-structured PBR system can provide new revenue streams, keeping utilities healthy while enabling third-party providers to develop and deploy everything from energy efficiency and other DERs to large-scale renewable power plants.

While we expand and evolve our state achievements, we must continue to support key existing markets, such as California and New York, which will be leaders in deployment for both RPS compliance and DG build out for years to come. We must take advantage of utility clean energy commitments, ensuring that when utilities like Xcel “trade fuel for steel,” the steel is solar. And we must also evolve our state advocacy to prioritize equity in the clean energy transition.

The growth of solar in the United States also provides a tremendous opportunity to address some of the greatest challenges faced by lower-income communities. And SEIA recognizes that expanding access to solar technology, savings and jobs requires state policies and programs that are specifically designed to address the unique barriers faced by low-income families and communities of color—who are disproportionately impacted by the negative effects of the fossil fuel economy and have the most to gain from a transition to affordable clean energy. Working with these communities will also help advance solar advocacy more broadly.

Next Steps

- ☐ Expand technical capacity and resources to engage in regulatory proceedings. SEIA-led (short-term)
- ☐ Capture solar gains in implementation of RPS legislation. SEIA+partners (short-term)
- ☐ Increase presence in markets with new load growth and retiring coal capacity. SEIA-led (short-term)
- ☐ Formalize state-level coordination with partners to strategically plan nation-wide build out. SEIA-led (mid-term)
- ☐ Work with partners to develop proposed solutions for utility business models. Develop alternative revenue streams for utilities as distributed energy sources increase and need for additional wires and substations and transmission and distribution expenditures decrease in some areas. SEIA+partners (long-term)
- ☐ Fully-fund 50 state strategy. SEIA+partners (long-term)

Market Access & Open Competition

Free and open access to electricity markets is a key component of achieving major increases in generation for solar and other clean energy sources. In particular, engaging with Regional Transmission Organizations (RTOs) to establish rules that allow wind, solar and storage fair and equitable access to markets and properly account for the multiple benefits that these resources bring will be critical. Only by incorporating into market design the true attributes (including ancillary services and reliability benefits) that solar can provide to the grid will we create the conditions for a sizable expansion of utility-scale solar.

SEIA has already begun an effort with the American Wind Energy Association (AWEA) to increase our presence during the RTO work groups and tariff development process that impact our industries, and that effort will need to continue and expand. SEIA and AWEA have cofunded an initial roadmap of RTO market rules and practices that will enable rather than inhibit clean energy deployment.⁹ Only through sustained engagement by the industry with these

organizations will we successfully realize the potential of these markets.

Whether at the RTO/Independent System Operator (ISO) level or in the distributed generation (DG) market, policies often support incumbent business models to the exclusion of new entrants who might push solarization faster. Existing RTO market rules were designed and adopted twenty years ago, based on the grid operations protocols from even earlier decades when the grid was dominated by large, slow-moving fossil-fired, nuclear and hydroelectric resources. There were few wind and solar generators, independent power producers and non-utility electricity purchasers. Since that time, there have been sweeping changes in electric fuel costs, technology capabilities, market structure and customer preferences, as well as computing power and communications technology to better manage the system. Future RTO markets, on the other hand, should be flexible, fair, far and free.¹⁰

Market reforms that will both ensure that electricity in the United States remains reliable and affordable, *and* that will enable market access for solar, storage and other clean energy resources include those in Table 2 below.¹¹

Table 2: Recommended Energy Market Reforms
(Source: Wind Solar Alliance)

Energy Market Reforms

- Ensure energy market prices reflect the value of reliability
- Bring self-scheduled resources into markets
- Multi-Day Unit Forecasts
- Price the inflexibility costs of conventional generators
- Ensure accurate, detailed generator bid parameters
- Reduce operational over-commitment of conventional units
- Create operating reserve zones
- Incent improvements in renewable energy forecasting
- Probabilistic Unit Commitment
- Respect bilateral contracts
- Allow flexible resources to bid flexibly without being inappropriately constrained by market power mitigation rules
- Allow real-time prices and demand response aggregation for electricity customers and allow demand resources to set prices
 - Streamline ISO seams
 - Use advanced grid technologies and operating practices to improve utilization of existing transmission

Reliability Services Reforms

- Reactive power compensation
- Remove barriers to renewable energy providing operating reserves like frequency regulation
- Primary frequency response markets
- Allow renewables to provide and set price for all reliability services
- Create additional flexibility products
- Make contingency reserves available to accommodate abrupt drops in renewable output

Capacity Market Reforms

- Respect state resource choices
- Allow MOPR to be avoided through bilateral contracts
- Ensure capacity markets reflect renewable resources' true capacity value
- Relax the requirement for capacity to perform year-round, and create seasonal rather than annual capacity products
- Allow storage participation in capacity markets
- Ensure conventional generators are not awarded excess credit relative to renewable resources
- Efforts to add a fuel security component to the capacity market should be abandoned unless demonstrated to improve reliability or efficiency
- Reform the capacity performance penalty structure to be symmetric
- Allow generators to retain their Capacity Interconnection Rights (CIRs) if capacity values change
- Allow hybrid projects for purposes of meeting market rules

⁹Gramlich et al, Customer Focused and Clean: Power Markets for the Future (Wind Solar Alliance 2018), https://windsolaralliance.org/wp-content/uploads/2018/11/WSA_Market_Reform_report_online.pdf

¹⁰Id. at 3

¹¹Id. at 5



Photo courtesy of PetersenDean Roofing and Solar Systems

Maintaining and increasing access for DERs at the distribution level requires a different toolkit aimed at similar results. Necessary policies include fair, non-discriminatory rate design (e.g. no “solar-only” charges or rates), transparent interconnection rules and procedures that yield prompt results at reasonable costs, and careful oversight of utility grid investments to ensure that “dumb” infrastructure investments do not crowd out or eliminate the value of third-party DER installations.¹²

Fortunately, it is possible to design utility revenue policies and rate structures so that utilities and their shareholders are rewarded for working

with their customers to encourage conservation and distributed generation of electricity, while at the same time sending price signals that more closely reflect the real-time supply and demand of energy on the grid. The goal is to provide more options for utilities and consumers; no one solution is perfect for every situation. Smart policy and informed public utility regulators can structure utility rates to provide win-win approaches for utilities, their customers and their shareholders.

Next Steps

- ❑ Advocate to and collaborate with ISOs/RTOs to ensure fair and equitable access to markets in restructured energy markets and with incumbent utilities to enhance competition in regulated markets. SEIA+partners. (short-term)
- ❑ Expand renewable energy engagement in all RTOs, including increasing funding to expand partnership with AWEA. SEIA+partners. (short-term)
- ❑ Fully engage in all RTOs. SEIA+partners (mid-term)
- ❑ Ensure market access for DG projects at the distribution level. SEIA-led (mid-term)
- ❑ Enhance market access for DG projects in RTO markets. SEIA-led (mid-term)

¹²O’Connell, How Dumb Distribution Spending Crowds Out a Smart Clean Energy Future, (GTM 11/5/18), <https://www.greentechmedia.com/articles/read/how-dumb-distribution-spending-crowds-out-a-smart-clean-energy-future#gs.36thio>

Managing Growth

Mature industries are successful when they anticipate the risks and challenges posed by long-term growth and mitigate their impact. Achieving the 20% goal depends on the way we handle those changes and act as a facilitator for the shift to cleaner electricity generation.

While the solar industry prides itself on being a disrupting force in the energy economy, our ability to become a major piece of the generation pie, especially in some state markets, will rely on the way we manage our growth and remove potential barriers before they pose greater risk to long-term success.

We are facing challenges on issues such as land use, recycling and workforce development, and these issues will only become more impactful as deployment levels increase. Developing strategies for these impacts now, rather than waiting until they become impossible to ignore, is critical.

Grid Modernization

Built during the last century, the United States electric grid was primarily designed to transport electricity from large central station power plants to end-use customers. But the rapid growth of distributed energy resources (DER) offers the promise of a more innovative, economic and cleaner electric grid.

“Decentralized control solves a few challenges for our changing grid. Billions of new energy devices generating energy from variable resources are difficult to manage centrally—the problem is too complex. Beyond the technical hurdles, our grids also need a new paradigm for resilience, protecting against natural disasters and cyberattacks.”

National Renewable Energy Laboratory

DERs, such as solar power, will play an important role in providing power and grid services where they are needed most. To reach this goal, however, distribution grid planning must evolve to allow more transparency into system needs, enable more robust data exchange between utilities and DER providers and include DER as a standard component of utility load forecasts.

For the distributed system, grid modernization opens the door to transforming our electrical infrastructure to better facilitate the flow of solar energy and incorporate energy storage technologies, both of which will enhance grid reliability and resiliency.

Grid modernization efforts should include establishment of a robust and transparent benefit cost framework to inform utility planning and ensure full and fair valuation of distributed energy resources.

Next Steps

- ❑ Encourage more states to engage in integrated distribution planning, incorporating scenarios of distributed energy resource adoption and processes for guiding distributed energy resources to provide alternatives (“non-wire alternatives”) to traditional utility investments. SEIA-led (short-term)
- ❑ Advocate for better utility data transparency to facilitate hosting capacity analysis, streamlined interconnection procedures, etc. SEIA+partners (short-term)
- ❑ Advocate for the establishment of a robust and transparent benefit cost framework to inform utility planning and ensure full and fair valuation of distributed energy resources vis-à-vis conventional utility investments. SEIA-led (short-term)
- ❑ Support infrastructure investments that will increase opportunities for DER deployment and load flexibility. SEIA+partners (mid-term)
- ❑ Engage in investigations to create independent distribution system operators (IDSOs). SEIA+partners (long-term)

Transmission

Substantially increasing solar on the grid will also require physical, technological and policy changes for utility-scale projects. To support growth for these projects, we will require transmission in the right places and fair interconnection policies.

One of the primary barriers to the continued development of solar generation is the lack of high-capacity transmission. Moreover, current transmission planning occurs on a state-by-state basis, with little regard to integrating renewable resources. These efforts have largely focused on intrastate transmission and have neglected to identify and prioritize transmission lines that provide regional and system-wide renewable

energy and reliability benefits. To reduce transmission barriers to the further expansion of utility-scale solar, we need a disciplined, well-coordinated, cross-jurisdictional regional-level transmission planning effort.

Resolving existing interconnection issues will be just as important. Currently, many promising solar projects are abandoned because of excessive costs or lengthy delays in the interconnection process. To successfully ramp up both the number of solar projects and cumulative installed capacity to hit our 20% goal, we must work with ISOs, RTOs and utilities to streamline the interconnection process, provide timely and accurate cost estimates and resolve technical questions regarding the interconnection of solar + storage projects.

Next Steps

- ☐ Develop specific infrastructure requests that include grid modernization and transmission expansion. SEIA-led (short-term)
- ☐ Establish pan-renewable transmission advocacy team. SEIA+partners (short-term)
- ☐ Improve interconnection process for solar and solar + storage projects. SEIA+partners (short-term and mid-term)
- ☐ Advocate for federal infrastructure investments that include grid modernization and transmission expansion. SEIA-led (mid-term)
- ☐ Enhance transmission capabilities that provide regional and system-wide renewable energy and reliability benefits. SEIA+partners (long-term)

International Trade

As solar has moved from niche products to a mainstream energy source, the U.S. solar supply chain has become increasingly intertwined with international supply channels. Products manufactured domestically often rely on imported materials or may go between the U.S. and foreign countries before being imported as the final product. An increased reliance on imports has also led to increased trade conflict.

Since 2012, the solar and other renewable energy industries have experienced the adverse impact of U.S. tariffs, with nearly every solar article or

major component/input imported into the United States now subject to some form of tariff. Most recently, the solar Section 201 global safeguard tariffs have led to billions of dollars in lost U.S. investments and thousands of lost American jobs.

And while the solar safeguard tariffs have also resulted in new investments in U.S. solar module manufacturing capacity, other U.S. solar manufacturers have suffered. Rather than picking winners and losers among different market segments through tariffs, a much better solution is to focus on developing state and federal policies and investments targeting the entire U.S. solar manufacturing supply chain.

Next Steps

- ☐ Monitor global trade actions to anticipate potential supply chain impacts. SEIA-led. (short-term)
- ☐ Proactively engage in collaborative dialogue to address global competitiveness issues. SEIA-led. (short-term)
- ☐ Continue to advocate for removal of tariff barriers, including Section 201 and 301 duties. SEIA-led (mid-term)

Manufacturing

To reach the 20% by 2030 goal, it will be necessary to significantly expand solar manufacturing capacity for both PV and CSP. Indeed, under SEIA's 2030 scenario, the U.S. will install more than 70 GW of solar equipment in 2030 alone. In contrast, total global module capacity is currently estimated at 144 GW and U.S. module capacity at 6 GW.¹³ The Solar+ Decade therefore presents an enormous opportunity to dramatically expand solar PV manufacturing in the United States.

Approximately 80% of the supply chain for CSP plants built in the U.S. comes from the United States. As installed capacity for CSP grows, there is a significant opportunity to increase U.S. manufacturing for CSP and related components. There are multiple benefits to growing U.S. solar manufacturing, including jobs, economic development and helping to ensure the United

States continues to be a leader in solar technology and innovation. Manufacturing is an intensely competitive sector, however, and overseas manufacturers often receive considerable support from local and national governments. To help ensure U.S. manufacturers are able to succeed in this environment, the United States must leverage its unique technology and innovation ecosystem, including national labs, regional and local incubators and the venture capital investment community.

The solar industry must also take responsibility for driving a public-private dialogue on how best to support U.S. solar manufacturing and include solar manufacturers, service providers, state and federal government representatives and the investment community. The dialogue should focus on addressing barriers to U.S. solar manufacturing and identifying policies and initiatives for incentivizing U.S. manufacturing investments.

Next Steps

- ☐ Create a public-private dialogue to support and expand U.S. manufacturing, including exploring non-trade policies and opportunities. SEIA-led. (short-term)
- ☐ Develop state and federal policy proposals for incentivizing U.S. manufacturing. SEIA-led (short-term)
- ☐ Increase U.S. manufacturing capabilities and opportunities. SEIA+ industry (mid-term)
- ☐ With the establishment of a manufacturing division at SEIA, increase advocacy in support of growing the U.S. solar supply chain. SEIA-led (mid-term)

Resiliency & Cybersecurity

Cybersecurity concerns will play an increasingly important role in the solar industry. In addition to the national security risks posed by cybersecurity breaches, they also present a reputational risk to the solar industry, particularly given the increased adoption of solar products that incorporate communications technology. But cybersecurity also provides an opportunity for solar technology, given its ability to scale at the modular level and create resilient microgrids.

Like every energy stakeholder, it behooves the entire industry to consider cybersecurity as key to any present or future energy initiative. As solar continues to proliferate and expand across North America, the solar industry must encourage

everyone within the solar supply chain to make cybersecurity a priority.

Resiliency is another key element of the solar+ goal. Solar equipment must be a dependable source of power through various types of stress, including catastrophic events. And ensuring resiliency requires a focus on developing technological solutions for reliability, including developing industry guidance for equipment corrosion protection in design and installation, establishing grid management and source-based maintenance programs that ensure integration as main or back-up systems and developing industry-wide procedures for operations and maintenance. Resiliency will also provide many opportunities for revenue generation.

¹³NREL, Q4 2018/Q12019 Solar Industry Update <https://www.nrel.gov/docs/fy19osti/73992.pdf>

Next Steps

- ❑ Increase industry awareness of grid cybersecurity risks, including holding an education and policy workshop. SEIA-led (short-term)
- ❑ Increase solar industry participation in federal grid cybersecurity initiatives. Industry-led (short-term)
- ❑ Establish and advocate for regular updates of industry-vetted procedures for equipment and system design and operations and maintenance of installed systems. SEIA-led (short-term)
- ❑ Collaborate with other stakeholders such as ASCE, NREL, NFPA and other codes and standards development organizations to ensure fair, reasonable and reliable requirements are developed. SEIA-led (short-term)

Consumer Protection

With more than two million residential systems installed to date and over 300,000 systems installed in 2018 alone, residential solar is now mainstream. Thousands of companies across the nation are responsibly working with customers to provide high quality solar at competitive rates. But the industry must also continue to call out and take a stand against less responsible actors.

Since 2015, SEIA's Consumer Protection Committee ("CPC") has been working to ensure consumers, industry and government officials fully understand solar technology, transactions, rules and resolution options. The CPC developed a national, industry code of conduct which presents rules for marketing, advertising and contracts along with a self-regulation program to help both consumers and industry.

Organizations like the Coalition for Community Solar Access have adopted SEIA's code of conduct for their members. The CPC also publishes consumer guides and disclosure forms for rooftop and community solar that offers a streamlined, straightforward explanation of key parts of solar contractors and questions consumers should ask solar companies and of themselves. SEIA has used these toolkits as the backbone for state-level consumer protection legislation. While SEIA and the industry have achieved a lot in the past four years, the time is ripe to expand our efforts.

SEIA has recently begun working with others in the solar supply chain, such as loan providers and lead generators. SEIA's code of conduct has required its members to take reasonable steps to oversee their service providers (e.g.,

lead generators). Now, SEIA will work directly with groups representing service providers to strengthen their codes of conduct and offer solar-specific guidance. This will help the industry reinforce best practices throughout the entire value chain.

Consumer protection increasingly ties in with other industry initiatives. For example, the success of the SolarApp program depends on AHJs having confidence in the behavior and workmanship of solar contractors. Industry efforts, like codes of conduct and training, will be vital to programs like SolarApp.

It also important to continue proactive engagement with government actors and consumer groups. Given the interest of states and federal government in solar energy and the level of activity on consumer protection issues broadly, SEIA will continue to work with government officials to promote stronger connections and communications. Such efforts will allow the industry to proactively respond to concerns before issues spiral out of control. Consumer groups can share information about solar with their constituents while helping the industry better understand consumer needs.

Continuing to advocate for consumer rights and responsible industry practices will be critical as we look to install more than 12 million additional rooftop solar systems during the Solar+ Decade. SEIA must remain committed to strengthening industry best practices, expanding its efforts and audiences and supporting policies that protect consumers while allowing solar companies to provide low-cost solar to homeowners in every community.

Next Steps

- ☐ Strengthen industry self-regulation to help consumers identify businesses that demonstrate high levels of competence and ethics. SEIA-led (short-term)
- ☐ Coordinate with other industry initiatives. SEIA+partners (short-term)
- ☐ Educate the industry through a variety of communications of relevant guides and model contracts. SEIA-led (short-term)
- ☐ Expand collaboration with state affiliates on consumer protection issues. SEIA+partners (short-term)
- ☐ Expand collaboration with related industries on consumer protection issues. SEIA-led (short- and mid-term)
- ☐ Increase outreach to government agencies with oversight or enforcement authority to explore collaborative opportunities. SEIA-led (mid-term)

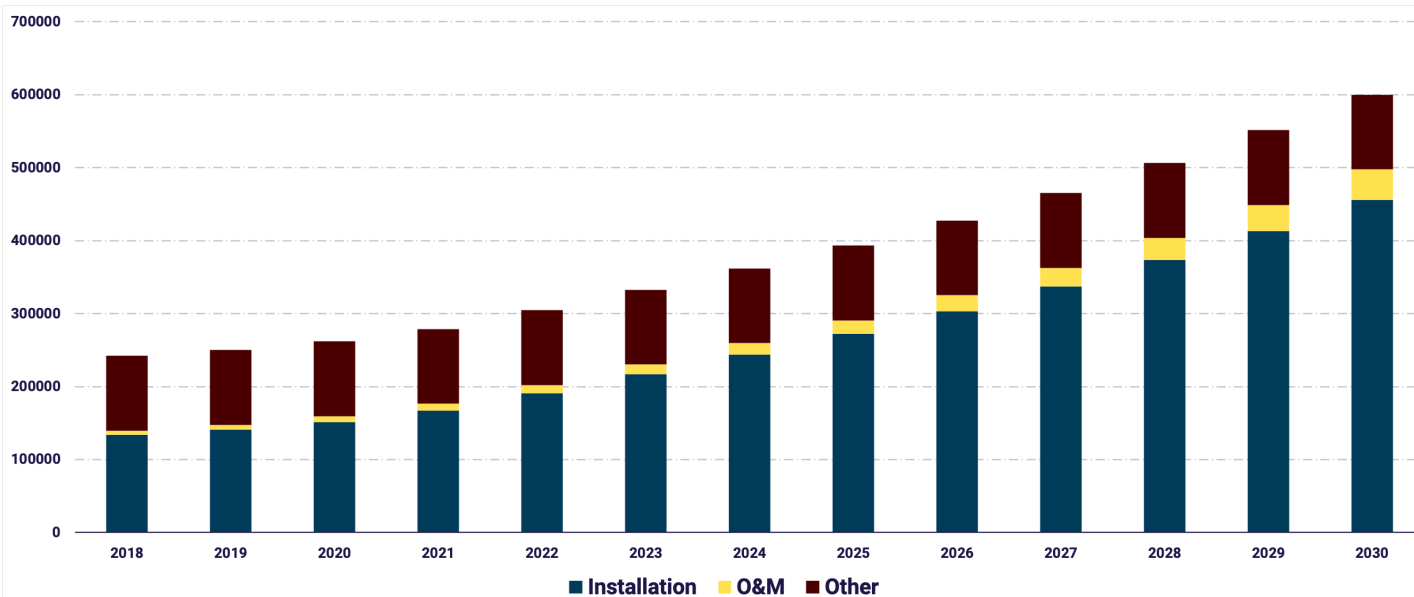
Workforce Development & Diversity

The long-term growth and success of the solar industry depends on a strong and healthy workforce. According to a recent survey of solar employers, more than 80 percent of respondents reported difficulty finding qualified job candidates.¹⁴ To reach 20% of generation by 2030, our estimates show that nearly 400,000 jobs will be added over the next decade, with many of them coming in emerging states and regions that

will require significant training and workforce development.

We also must build a diverse workforce that reflects our country. Not only is increasing workforce diversity and inclusion the right thing to do, it also makes sound business sense. According to McKinsey, ethnically diverse companies are 33 percent more likely to be more successful than their peers.¹⁵ Our success as an industry depends on a diverse workforce; we will make better, more creative decisions when we have more varied voices at the table.

Figure 7: Solar Industry Workforce on the Path to 20% Generation by 2030



¹⁴Solar Training and Hiring Insights 2017, Solar Training Network, available at: <https://www.americansolarworkforce.org/wp-content/uploads/2018/09/sthr.pdf>

¹⁵Delivering through Diversity, January 2018, McKinsey & Company, available at: <https://www.mckinsey.com/~media/McKinsey/Business%20Functions/>

"As the solar industry matures, we have to start acting like it. We need to build a strong pipeline of talented workers in every sector of the solar supply chain – from sales to installation, manufacturing to finance. The data shows that solar jobs are well-paid and accessible to Americans from every walk of life. We need to go into local communities and make sure folks are aware of the solar opportunity, and get them what they need to join this incredible industry."

George Hershman
President
Swinerton Renewable Energy

"In 10 years, solar will be paired with so many other things – with energy efficiency, with storage, with clean mobility. And in order to get there, we need to think about equity in everything we're doing. And how are communities closest to the problem going to be in charge of the solutions."

Erica Mackie
Co-founder & CEO
GRID Alternatives

Next Steps

- ☐ Form partnerships with training providers, community-based organizations and the public workforce system to better educate the public about solar employment opportunities. SEIA-led (short-term)
- ☐ Invest in training programs across all levels, establish strong relationships with local, state and federal workforce development programs and connect with communities of all backgrounds to build an equitable and inclusive workforce. SEIA-led (short-term)
- ☐ Educate the solar industry on diversity, equity and inclusion best practices and resources. SEIA-led (short-term)
- ☐ Build a workforce that better reflects our country. Industry-led (mid-term)
- ☐ Develop partnerships with other industries to implement effective workforce and O&M best practices. SEIA+industry (long-term)

Land Use

Getting to 20% will require a more sophisticated approach to land use decisions and community engagement for the solar industry. While there is more than enough available land to reach our goal, there are opportunities for efficiencies. There are also many opportunities to site solar projects on land used for other purposes, including brownfields, unproductive agricultural lands, active farmlands and land adjacent to decommissioned fossil power plants that provide previously disturbed land and access to transmission.

A utility-scale solar power plant, whether PV or CSP, may require between 5 and 10 acres per megawatt (MW) of generating capacity, including land used for panel spacing, access roads and transmission lines.¹⁶ As solar technology improves, we will be able to produce more energy with less space. The availability of new

and existing transmission will also affect where projects are built.

As we grow, the industry must share responsibly for being good stewards of the land and to build community support for each of our projects. Taking lessons from other energy industries, we can identify tried and true methods for building that support.



Photo credit: NREL, Dennis Schroeder

¹⁶NREL, Land-Use Requirements for Solar Power Plants in the United States <https://www.nrel.gov/docs/fy13osti/56290.pdf>

Solar can be an economic driver for communities, including the agricultural community. At a time when many agricultural producers are struggling, solar creates additional revenue streams and helps support farmer incomes. Some farmers have even begun to co-locate their solar investments with other forms of agriculture production.

Solar farms themselves can support a greater diversity of plants as well as greater numbers of butterflies and bees, particularly under management which focuses on optimizing biodiversity when compared to equivalent agricultural land. This increase in plant and invertebrate availability may lead to more opportunities for foraging birds. When joint solar and vegetation designs are developed,

the benefits achieved can be maximized. When farmers and solar work together, there is additional revenue for farmers, increased solar sites, increased energy production and reduced maintenance expenses.

Building long-term relationships with landowners, land managers, local communities and regulators requires a strong commitment and on-the ground engagement. The industry needs to work together to create and commit to best practices relating to land use and community engagement. This includes a stronger set of services and tools to educate local communities and county commissioners about the benefits of solar and potential multi-use opportunities associated with solar deployments to ease project review and approval timelines and processes.

Next Steps

- ☐ Develop industry best practices for land use and community engagement. SEIA-led (short-term)
- ☐ Create a land use toolkit for engagement with local governments, communities, etc. SEIA-led (short-term)
- ☐ Develop partnerships with local and national agricultural advocacy groups, including the Farm Bureau, local Economic Development Corporations (EDCs) and state associations of counties. SEIA-led (short-term)
- ☐ Develop an education campaign focused on land use issues and the value of solar for rural and agricultural communities. SEIA+partners (mid-term)
- ☐ Establish a sophisticated, locally-driven solar engagement plan to support solar expansion. SEIA+partners (long-term)

Sustainability

While solar panels are built to last decades and we do not expect significant module retirements until the 2030's, the industry must plan ahead to ensure module waste is handled responsibly.

With more than 500 gigawatts (GWdc) of photovoltaic (PV) modules installed globally¹⁷ (including 62 GWdc in the U.S. through 2018), end-of-life management is important for all PV technologies to ensure clean energy solutions are a sustainable component of the energy economy for future generations. Like many other durable products and construction materials, solar equipment can last for decades, particularly with proper maintenance. In some cases, PV modules can be reused or refurbished to have a “second life” of generating electricity.

The other components of solar systems can also be handled responsibly. Inverters can be recycled in existing recycling streams and racking equipment can be re-utilized with newer technology or recycled like other metals. High-value recycling can help minimize life-cycle impacts and recover valuable and energy-intensive materials, thereby increasing sustainability within the PV industry. Recycling of solar equipment is increasingly possible as more recyclers accept modules. PV panels typically consist of glass, aluminum, copper, silver and semiconductor materials that can be successfully recovered and reused. By weight, more than 80 percent of a typical PV panel is glass and aluminum – both common and easy-to-recycle materials.

¹⁷NREL, Q4 2018/Q12019 Solar Industry Update <https://www.nrel.gov/docs/fy19osti/73992.pdf>

Next Steps

- Consider developing a stringent refurbishment process to safely bring modules into the secondary marketplace. SEIA-led (short-term)
- Assess development of national entity to administer direct services to members and industry-at-large. SEIA-led (short-term)
- Expand SEIA's PV Recycling Network.¹² SEIA-led (mid-term)
- Support R&D of PV-specific recycling equipment that can economically optimize the recoverability of reclaimed materials. Industry-led (mid-term)
- Consider developing an industry recognition program for solar companies with broad sustainability initiatives including sourcing, design and end-of-life management. SEIA-led (mid-term)



Photo courtesy of Swinerton Renewable Energy

¹²<https://www.seia.org/initiatives/seia-national-pv-recycling-program>

Achievability

While the 20% by 2030 goal is certainly achievable, it is not inevitable. The industry's march to 2030 must be immediate, aggressive, collaborative and national in scope. The strategic areas of focus outlined in this roadmap have been identified by industry leaders as factors that will have significant impact on long-term growth.

To fundamentally reshape our future, we must invest our resources on these issues, and put our political clout behind them. To successfully develop policies that drive growth, and to mitigate potential risks, we will need active engagement from outside of the solar industry. Solar energy enjoys broad public support, and is favored across the political spectrum as an energy source of the future. Taken as a whole, there is increasing public demand for all forms of clean energy, and it is incumbent upon us to capture this enthusiasm and turn it into meaningful action that will achieve results. There are more than 2 million Americans with a residential solar system, and some of the nation's most successful and recognizable corporate brands are turning to solar and other clean energy sources to power their businesses. We need to convert these customers into advocates, and use this clout to achieve policy victories.

Solar and other clean energy technologies are up against entrenched and well-funded interests. Our fundraising and advocacy will need to expand to make the Solar+ vision a reality. Continuing to build a robust political action presence, through the SolarPAC and other means, will be a key priority. Strategic partnerships are also critical for this work. Identifying outside interests, such as the environmental community, labor, conservative organizations, or rural economic development groups, to align with at key moments will help increase pressure on lawmakers.

It will also be important to recognize that the changing energy landscape will create challenges for incumbent energy providers and their employees and investors. Helping these companies and individuals manage the energy transition must be an important part of the solar+ decade.

As the national trade association for solar, and an organization committed to building a unified vision for America's clean energy future, SEIA is laser-focused on delivering concrete results that will make the 20% goal a reality. Through the deliverables and next steps outlined in this roadmap, and with strategic and intensive collaboration with allies across disciplines, we can remove barriers and create the necessary environment for a strong clean energy future for America.



Photo courtesy of ALDI, Inc.

Next Steps

Reading this roadmap is only the beginning. Here are some steps you need to take to help support this ambitious growth for solar and clean energy in the U.S.:

- ❑ **Support SEIA's advocacy** – many of the policy drivers outlined in this document will require extensive lobbying at the local, state and federal level. We are up against established interests with significant resources, and the only way to ensure favorable outcomes is to invest in a strong association to deliver advocacy wins.
- ❑ **Engage with the political process** – the most effective voice in any effort to persuade policymakers or the public is yours. Build relationships with your elected officials at all levels of government and engage in grassroots advocacy efforts. Engage with the SolarPAC to help the industry support solar champions on Congress.
- ❑ **Invest in public and regulatory affairs** – dramatic increases in solar penetration will require new customers who are not as familiar with the benefits of solar, and policy victories can only be achieved with active engagement from the voting public and from solar industry members. Supporting public awareness campaigns and public affairs work at the state and national levels will pay long-term dividends for the industry.
- ❑ **Lead the industry with integrity** – As advocates for a clean, affordable energy future for America, we have to grow in ways that protect consumers, communities and our land; meet the highest standards of health & safety; and build a vibrant workforce that reflects the diversity of our population. Your dedication to these pursuits will be critical in the years to come.



About SEIA

The Solar Energy Industries Association (SEIA®) is the driving force behind solar energy and is building a strong solar industry to power America through advocacy and education. As the national trade association for the U.S. solar energy industry, which employs more than 242,000 Americans, we represent all organizations that promote, manufacture, install and support the development of solar energy. SEIA works with its 1,000 member companies to build jobs and diversity, champion the use of cost-competitive solar in America, remove market barriers and educate the public on the benefits of solar energy.



Learn more about SEIA's Solar+ Vision at:

www.seia.org/SolarPlus