



The Solar+ Decade

Leading the Energy Transition

*A new roadmap for building
the Solar+ Economy*

Sep.
2022

Solar + Storage

Environmental Justice

Energy Market Access

Workforce Development

Open Competition

Climate Policy

Codes & Standards

Energy Storage

Diversity & Inclusion

Recycling & Sustainability

Land Use



Cost Reduction

Federal Tax Policy

Building Codes

Grid Modernization

International Trade

Consumer Protection

Cybersecurity

Transmission

State RPS

Renewable Collaboration

Resilience

Net Metering & Rate Design

Domestic Manufacturing

Local Permitting

Electrification

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Executive Summary

This roadmap offers a vision for the radical transformation and decarbonization of the U.S. electricity system. It articulates where the solar industry stands today, establishes new goals for the next decade and outlines the steps we must take to get where we want to go. The pages that follow lay out how the solar industry will expand exponentially from comprising 3.7% of the U.S. electricity mix today to 30% of all electricity generation by 2030. This will put solar on pace to provide essential reliability services, deploy with storage for resilient community infrastructure and fully decarbonize the electric grid by 2035.

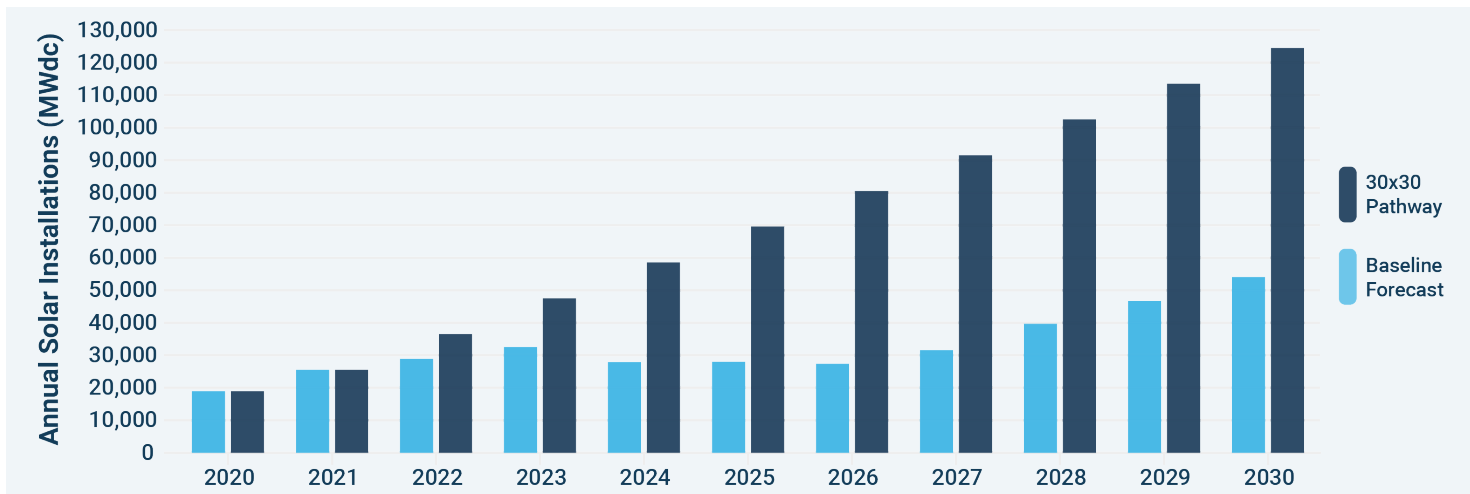
When SEIA established the original Solar+ Decade goal (20% of generation by 2030) in 2019, it was seen as an ambitious but achievable goal. In light of historic changes – shifting political dynamics, increased urgency to address climate change and changes in market dynamics – the potential for solar growth has only increased. However, this transformation requires a collaborative, well-funded effort led by a strong national trade association.

We have identified four significant pillars of our plan to reach 30% by 2030 through radical market transformation:

- We must work constructively with other industries and organizations that share our vision. While our goal is predicated on solar penetration, we envision an electricity portfolio comprised of multiple 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, transmission and distribution infrastructure, wind energy and any number of other technologies that will advance the solar vision and transform energy markets.
- There are a number of **market accelerators** that can increase solar energy adoption. Capitalizing on these accelerators, including energy storage deployment, electrification of thermal loads and transportation and carbon reduction goals, 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, federal tax policy, state net energy metering rules, strong industrial policy and manufacturing investments, 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 continue to **manage our growth**. Our industry must build a robust and ethical domestic supply chain, earn a social license to operate by being good stewards of the land, proactively address recycling and end-of-life management, modernize the grid to facilitate more solar deployment, ensure smart trade policy, protect customers and develop a diverse customer base and workforce, among many other priorities.

Why set this goal of 30% by 2030 and articulate a vision of radical market transformation? Because, when we achieve this goal, we will have deployed 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 and make a significant contribution to addressing climate change. And we will increase prosperity for all Americans by creating economic opportunity and clean abundant electricity for all of our communities.

Figure 1: Annual Solar Installations (GW) Required to Reach 30% of Generation by 2030



In May 2019, SEIA convened a group of industry leaders to establish the Solar+ Decade vision and begin crafting the original Roadmap. To explore recent developments and their impacts on our future, SEIA brought many of these same leaders together again, along with new voices and perspectives, for virtual focus groups in Summer 2021. Throughout this document you will find quotes from these conversations that provide a glimpse into industry perspectives on our biggest challenges and opportunities.

Since establishing the original Solar+ Decade Roadmap in 2019, SEIA and the industry have made considerable progress on several of the actions identified to advance our vision, including the passage of a landmark federal clean energy bill, the Inflation Reduction Act, which creates unprecedented long-term policy certainty and tools for accelerating deployment and U.S. manufacturing. As we continue to revise and update this 2030 roadmap, we are also re-evaluating the required next steps in collaboration with industry leaders and external partners. In May 2022, SEIA convened another strategic summit to drill down into the actions that SEIA, our members, and actors throughout the clean energy economy must take in the coming years to realize the 30x30 vision. The takeaways from this summit are articulated in the updated Foreword.

SEIA is well positioned to lead this radical move to a clean energy economy. However, the solar industry writ large will need to undergo many changes. 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.



Foreword

The Vision

Over the last decade, the U.S. solar industry experienced an average annual growth rate of more than 50%. Installed solar capacity now exceeds 130 GWdc across more than 3 million systems nationwide, compared to less than 2 GW and 100,000 systems at the end of 2009. But despite this incredible growth, solar accounts for about 4% of all electricity generation today.

In May 2019, SEIA convened more than 100 leaders from across the solar and solar + storage industry to build a long-term vision for the clean energy economy. 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.

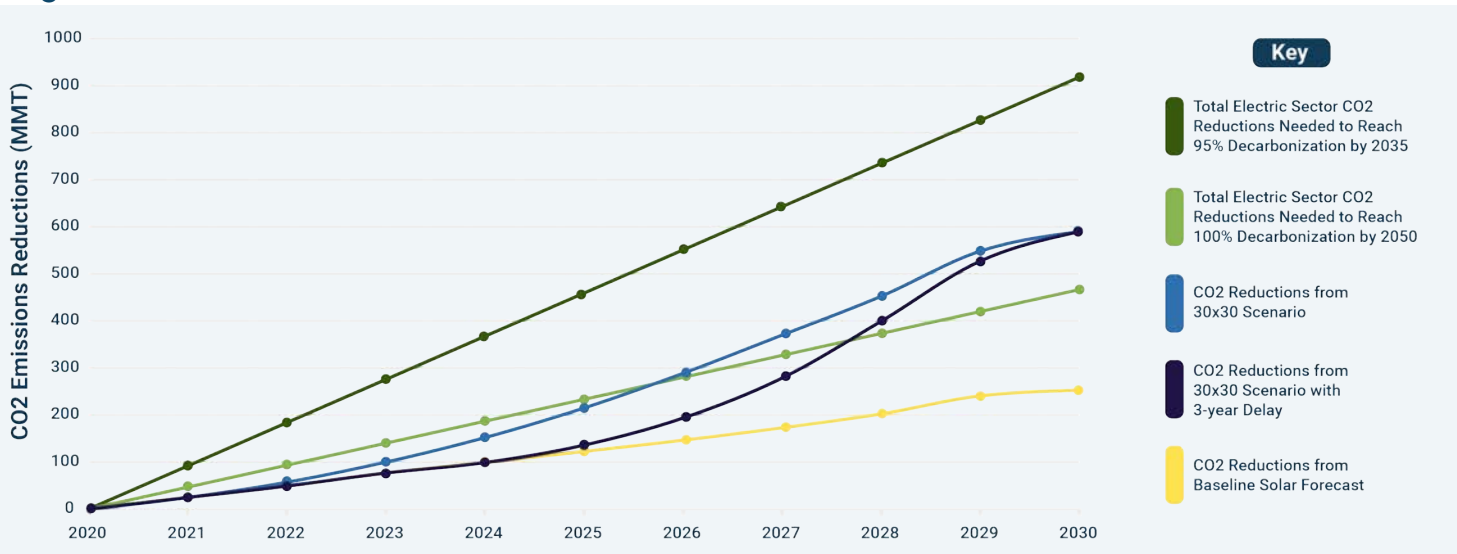
In the three years since this Roadmap was first published, the U.S. economy, and the energy sector in particular, has experienced historic changes. Increased urgency to tackle climate change and cut carbon emissions, the unprecedented challenges of the COVID-19 pandemic and the passage of the most

transformative federal clean energy policy in history have all left their mark on the clean energy economy.

The combination of all these intersecting factors has only increased the potential for solar and storage growth. As a result, in September 2021, SEIA announced a new target for the Solar+ Decade: for solar to reach 30% of all U.S. electricity generation by 2030. In May 2022, we reconvened our members and industry stakeholders to revisit the Solar+ Decade Vision and discuss meaningful actions in the short, medium and long term that will be necessary to achieving our ambitious goals.

Then, in late July 2022, the very future of the U.S. energy economy was transformed when Congress passed the Inflation Reduction Act (IRA), which included long-term extensions of the investment tax credit (ITC), new standards for workforce development, investments in domestic manufacturing of clean energy products, a standalone tax credit for energy storage, and much more.

Figure 2: 30x30 Puts U.S. on Path to Electric Sector Decarbonization



This historic policy achievement offers an opportunity to double down on the vision for reaching 30% by 2030. The IRA is not a silver bullet solution that will solve all of the many challenges facing solar and storage businesses in America, and the transformational growth it enables will only be possible through concerted efforts to remove market barriers, scale up projects responsibly, and defend and expand the industry's hard-won victories.

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

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 a clear path to overcome barriers and make the most of the opportunities before us.

What 30% by 2030 will look like:

- The U.S. solar industry will be a 125 gigawatt (GWdc) annual market by 2030, up from 19 GWdc in 2019
- Solar will represent the largest source of new power generation annually
- 850 GWdc of solar will be installed by the end of 2030, or 930 GWdc if overall electricity load increases by 10% due to electrification
- \$120 billion will be invested in solar development each year
- Solar installations will need to grow annually by roughly 17.4% over the next ten years

- Solar will be installed on roughly 17 million rooftops
- Solar will employ a growing workforce of more than 1 million Americans. The solar workforce and the consumers we serve will reflect the diversity of our nation
- Solar will be responsible for reducing more than 700 million metric tons of greenhouse gas (GHG) emissions annually by 2030, or roughly 35 percent of all electric sector GHG emissions
- 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 50 GW domestic manufacturing base and a robust U.S. supply chain across all system components
- Solar will enhance America's energy and national security through diversification of energy resources, strengthening our energy infrastructure, providing resiliency to homes and businesses and the overall grid, powering military bases and other means



What It Will Take

To reach our 30% by 2030 goal, the industry must pursue policies that facilitate solar deployment and incorporate other technologies and stakeholders. It is incumbent upon SEIA and our allies to create a shared clean energy vision and write a new story for U.S. energy in the 2020s.

In addition to policy drivers that open markets and create new demand, the industry is entering a new era of growth that will be defined by the factors that restrict growth and create risk for businesses. To reach the peak of our potential, we must take responsibility for our exponential growth and proactively address the current and future barriers that will impeded our progress.

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 annual deployment will need to increase substantially. Solar will 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 to put solar on the trajectory to meeting ambitious goals for U.S. energy generation, job creation, economic development and climate action.

During the May 2022 Strategy Summit, stakeholders and industry leaders discussed the vast universe of challenges and opportunities facing clean energy businesses in the coming decade, and sought to prioritize the actions that would have the greatest impact in the short, medium and long term. Through this work, a series of key themes and core priorities were identified. This Roadmap explores a wider universe of areas that will be critical to achieving the 30% goal, while the factors highlighted here represent an attempt to rally the industry and our allies around certain core efforts.

Key Topical Priorities

Though the universe of issues the industry must address is vast, business leaders have coalesced around 5 core areas that are especially pivotal to scaling up from 4% of generation to 30%.

- **Enacting smart, effective state-level policies.** State legislative and regulatory decisions will have enormous impact on where solar and storage can be deployed, the compensation customers receive, and more. SEIA will continue fighting hard to ensure the rules and regulations governing energy buildout in the U.S. are conducive to competitive solar and storage businesses.
- **Streamlining permitting, interconnection, and transmission processes while bolstering community engagement.** There are many intertwining and complex factors that must be considered as clean energy scales. Ensuring that siting and permitting processes are clear, transparent, and not overly burdensome for developers, while keeping community engagement and support top of mind, will be paramount for the industry moving forward.
- **Scaling a diverse workforce.** To reach our 2030 goals, the industry will need to hire more than 800,000 new workers by the end of the decade. Creating sustainable and scalable workforce development strategies that prioritize diversity, equity, inclusion, and justice will be critical.
- **Fostering a robust domestic supply chain and a life-cycle view of manufacturing.** Both the IRA and President Biden's use of the Defense Production Act provide highly valuable tools for increasing domestic production of goods for the solar and clean energy supply chains. Ensuring these tools are maximized and the promise of a sustainable American clean energy manufacturing renaissance is realized will be a core priority for the industry in the near term.
- **Strategic advocacy and engagement on building codes & product standards.** For customers to take full advantage of a growing portfolio of distributed energy resources, and for large-scale solar and storage projects to flourish, the industry must increase its attention and engagement to codes and standards to bring down costs and ensure a high standard of product quality.

Cross-Cutting Themes

In addition to topical priorities that spanned a wide variety of issues and aspects of the energy economy, the industry identified three essential themes that will define the Solar+ Decade's success.



Building Political Power

The successful nationwide advocacy campaigns that resulted in President Biden's emergency supply chain declaration and passage of the IRA demonstrated the importance and impact of political organizing, fostering relationships with government leaders, and committing to a long-term strategy. To address any of the issues described in this Roadmap, the solar and storage industries must continue to expand our influence, invest in political engagement at higher levels, and develop long-term plans to advance our interests.

Top-down Reforms & Policy Standardization



The clean energy industry has spent valuable resources and time fighting too many battles at once, with competing states and jurisdictions adopting inconsistent policies to address common challenges. Piecemeal solutions to market access and grid reform will only serve to slow down the clean energy transition. The industry will be better served seeking holistic, top-down strategies that help standardize and simplify regulatory structures.



Long-term Business Certainty

The "solarcoaster" of the last several years, including cycles of tariffs and trade wars, waxing and waning tax incentives, and state-level regulations that require constant updating or expansion has stifled solar and storage growth. To increase access to low-cost capital and ensure stable growth, businesses need a policy environment that is predictable over the long term. While the multi-year tax incentives passed in the IRA are a major piece of this puzzle, work remains on a variety of fronts to create long-term certainty and policy durability.



Collaboration

Achieving the 30% 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 the necessary public and political support.

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

In addition to increased coordination within the solar industry, achieving the 30x30 vision will require aggressive collaboration across the clean energy space. We must collaborate closely with the wind and storage industries and other related technologies to create a comprehensive clean energy policy framework. We need to work with other partners to make investments in 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 incumbent resources and other interests that are moving toward obsolescence.

Many utilities are embracing clean energy, particularly solar. Long-term, sustainable solutions to our energy challenges will be those that benefit utilities, electricity customers and solar companies alike. To reach a clean, reliable and secure grid, utility business models must transition to better align with these goals.

As the solar industry has matured, we are seeing greater investments from incumbent energy producers in clean energy deployment. The Solar+ Decade will afford us the opportunity to partner with these major players in the energy industry on the future of the energy system.

The solar industry must also expand its

collaboration with commercial and institutional buyers, including large corporations, state and federal governments, and colleges and universities, who are helping lead the way toward a solar+ future. It is equally important that we strengthen our relationships and coordination with long-standing partners such as climate and environmental advocates, while we simultaneously seek opportunities for new allies and supporters of solar energy, including conservative partners and rural economic development organizations. The environmental and economic benefits of solar energy have no party affiliation and offer the chance to build a broad coalition of support.



Market Accelerators

There are economic and political dynamics beyond the solar industry that present a major opportunity to accelerate our growth. Reaching the 30% 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 increase standalone solar capacity value, smooth electricity prices through arbitrage, manage evening energy ramps, mitigate the risk of curtailment, provide black start capability, provide backup power, function as a transmission resource and more. For distributed projects, storage can help customers manage the move toward time-of-use (TOU) pricing and later TOU periods, give system owners access to the power from their solar panels for more hours of the day, and provide resilience during grid outages.

The cost of lithium ion batteries has fallen by 85% over the last 8 years as manufacturing has scaled up to support both electric grid applications and electric vehicles.¹ 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.

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 30% of total energy generation and beyond depends on the cost-effective integration of storage.



Vested, incumbent interests are the biggest contributors to wholesale market design. Having full access to energy markets for solar and storage projects would mean more of these projects get built, period.

Solar + storage is increasingly cost-effective today. 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” (emphasis added).² 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.

Of course, deploying storage is not without challenges. Interconnection of solar and storage resources remains challenging, with significant variation in rules from different utilities and regulatory bodies. Adding storage to a planned solar project while it is in an interconnection queue can result in loss of queue position. Firefighting, first responder training, and other in-situ and operational safety concerns must be addressed and overcome in the development and siting processes for storage projects. The codes and standards development surrounding the installation of solar and storage are significantly different throughout the U.S.; training resources available to first responders is not uniform or consistent in funding or availability. Through more proactive training with industry endorsement of programs, it is possible to build additional solar and storage allies in the fire protection community.

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/>

Carbon Reduction

Climate change is the defining issue of our time. Climate-related catastrophes are becoming more commonplace, more destructive, more costly and impossible to explain away. These events are influencing public opinion and pushing climate deniers further to the margins. These changing perceptions and political dynamics are leading to a greater emphasis on clean energy to address what is now considered by many Americans to be a climate crisis.

In a 2021 survey, published by the Yale Program on Climate Change Communication and the George Mason University Center for Climate Change Communication, 53% of registered voters said that global warming should be a high or very high priority for policy makers, and 66% said that developing sources of clean energy should be a high or very high priority. Eight in 10 supported achieving those ends by providing tax breaks to people who buy electric vehicles or solar panels, and by investing in renewable energy research.

According to the Intergovernmental Panel on Climate Change (IPCC) report released this past summer, “It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.” The report goes on to say, “Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in carbon dioxide (CO₂) and other greenhouse gas emissions occur in the coming decades”.

The Biden administration has set a goal of eliminating carbon from the power sector by 2035. This will require solar to grow at 4 times its current rate by the end of the decade.

While there is growing political support for addressing climate change and adding more solar to the power grid, policy makers are generally split on a partisan basis for more aggressive climate legislation. Under our current political dynamic, meaningful climate legislation only has a path forward with nearly complete unity among Democrats to take bold action and expend the necessary political capital to prioritize these efforts.

However, climate initiatives cannot only be supported with large, sweeping goals, the U.S. government’s agencies also need to develop much more collaborative solutions and allocations of resources. SEIA is expanding its multi-agency reach, meeting and convening members with key leaders in the DOE, DOL, Interior, BLM, Treasury and others. Similar interagency collaboration requires leadership initiative from within the Biden administration.

This interaction requires SEIA to explore more direct program development, potentially funded by federal agency grants, that helps unravel the myriad of potential rules and regulations affecting the treatment of solar and storage. For example, workforce development programs that help educate consumers, industry, and stakeholders on carbon-free energy generating resources and maintain low-to-no-carbon effects at end-of-life could be developed and funded by the DOE. Technical safety programs that integrate fall safety and electrical safety into one comprehensive program for solar and storage workers and even first responders could be developed and funded by the DOL. These activities will require primary SEIA resources to monitor and propose such opportunities.

Based on existing market forces alone, solar deployment is on an upward trajectory. We have successfully built an industry with a low-cost product that creates jobs and economic growth. As a renewable, carbon-free resource, we are also part of any market or policy solution to address climate change. But more change is needed to accelerate the transition. 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.

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 needs and other strains on the electric grid. At the same time, increased load and flexible charging for EVs has the potential to decrease grid integration costs if done correctly.

Electrification of the transportation sector, which makes up the largest share of U.S. emissions, will require significant upgrades to our power grid, more ubiquitous charging stations and affordable

Accelerating solar and other clean energy deployment as quickly as possible to reach the ambitious goals of the Solar+ Decade and the Biden administration is pivotal to addressing climate change. The carbon emissions avoided in the next decade will be critical, and the costs of delay or inaction in mitigating the worst impacts of a changing climate will be severe.

While reaching 30% will help significantly reduce CO2 emissions by 2030, it will not alone address IPCC-identified reduction targets or the Biden administration's ambitions. 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.

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 projects that passenger EV sales will increase from 3.1 million in 2020 to more than 14 million by 2025, representing 16% of all sales.³

The solar industry must work hand-in-hand with the EV and charging industries to ensure coordination on interconnection and flexibility in charging to the mutual benefit of solar, storage, and EV sectors. Collectively, these industries can identify opportunities to reduce grid integration costs and timelines through strategic location or co-location of complementary assets.

“ We need to explicitly fold in electrification into our advocacy and expertise, engage more heavily at the RTOs/ISOs on the benefits of distributed energy resources, and work collaboratively with organizations in the electrification space.

³BNEF, Electric Vehicle Outlook 2021, available at <https://bnef.turtil.co/story/evo-2021>

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.⁴ But now, we have the opportunity to meet nearly all our buildings' energy needs with clean energy generation and storage, whether onsite or offsite 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 while increasing electric end use 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.



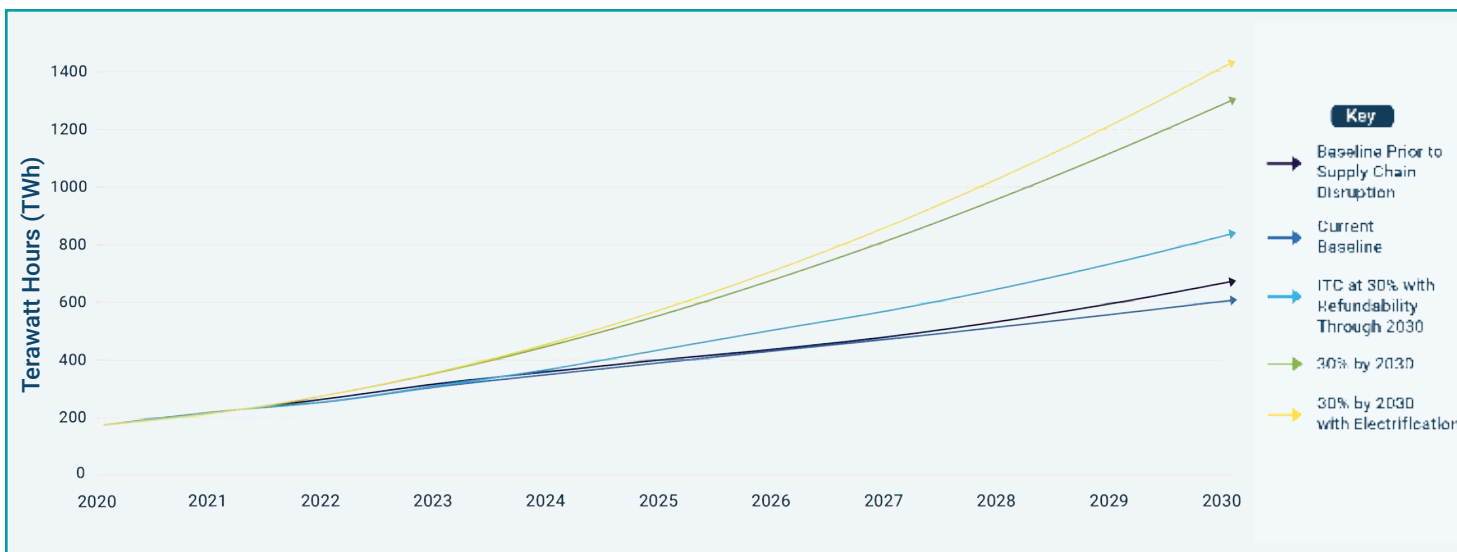
⁴RMI, "Electrifying Buildings for Decarbonization: The Role of Electric Space and Water Heating"
<https://rmi.org/report-release-electrifying-buildings-for-decarbonization/>

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 30% 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 3: U.S. Solar Generation (TWh) Across Policy Scenarios & Targets



Reducing Soft Costs

Cost reductions for project development (origination/customer acquisition, design, permitting, construction and interconnection) are pivotal to the Solar+ Decade. Our ability to dramatically increase generation depends on cost competitiveness. Equipment efficiency gains and decreased hardware costs will help but are already on a solid downward trajectory. Soft costs remain the most stubbornly high costs in the U.S. Other developed countries have implemented successful tools to reduce the costs of permitting and interconnection that enable system costs as low as half the cost of some systems in the U.S. In addition, lower transmission and distribution costs, the scaling of domestic 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 global 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 authority over requirements, application costs and approval times. A team of industry leaders, including SEIA and its members and the National Renewable Energy Laboratory have developed a platform called Solar Automated Permit Processing (SolarAPP+).⁵ This platform provides a streamlined, code-compliant process to increase efficiency and reduce the time and cost of a solar permit, which can lead to lower cancellation rates and overall system costs.

SolarAPP+ is available at no cost to jurisdictions. There are no software purchase or licensing fees and the NREL implementation team assists in every step of adoption. SolarAPP+ will significantly benefit local governments, which face fewer technically-experienced resources available, budget constraints and growing workloads to keep up with the accelerated pace of solar energy and storage development.

Automated permitting will reduce time spent and increase permit revenues, allowing AHJs to focus their resources on post-installation and inspections and more complex construction and installation projects. The soon-to-be-published NREL pilot report on SolarAPP+ shows that several jurisdictions reduced their permit issuance from as many as 20 days down to a few hours.

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

Finance & Tax

Generating the necessary investments to support a 125 GWdc annual solar market by 2030 is a significant challenge. As the market matures and grows, our revenue streams and contract structures also must evolve.

The COVID-19 pandemic and ensuing economic crisis, supply chain delays, and changes in the availability of tax equity have raised the need for a broader view of tax policy.

⁵NREL, SolarAPP+, available at: <https://solarapp.nrel.gov/>

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 requirement for new low-rise, residential construction in California to include solar systems, and efforts nation-wide to focus on decarbonization of building structures, integrating solar into relevant codes and standards has enormous potential for growth, and can help drive down costs across markets.

Manufacturing also presents an important 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. 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. Increasing domestic manufacturing capacity will help alleviate rising costs and delays associated with shipping, the unpredictable nature of trade disputes and other global logistics challenges.

Finally, interconnection processes and the associated grid upgrades required to add new solar projects to the grid add significant costs. The industry will need to work with regulators and utilities to streamline and improve interconnection procedures, ensure investments in transmission and grid upgrades are made proactively and that these costs are appropriately absorbed by the broader electricity market.

In the short term, the investment tax credit (ITC) continues to support extensive growth in the market and puts us in a better position to reach 30%. Since the ITC was enacted in 2006, the U.S. solar industry has grown by more than 10,000%. The two-year ITC extension at the end of 2020 increased the 10-year solar deployment forecast by 17%, demonstrating the powerful impact that this one policy has on solar growth.

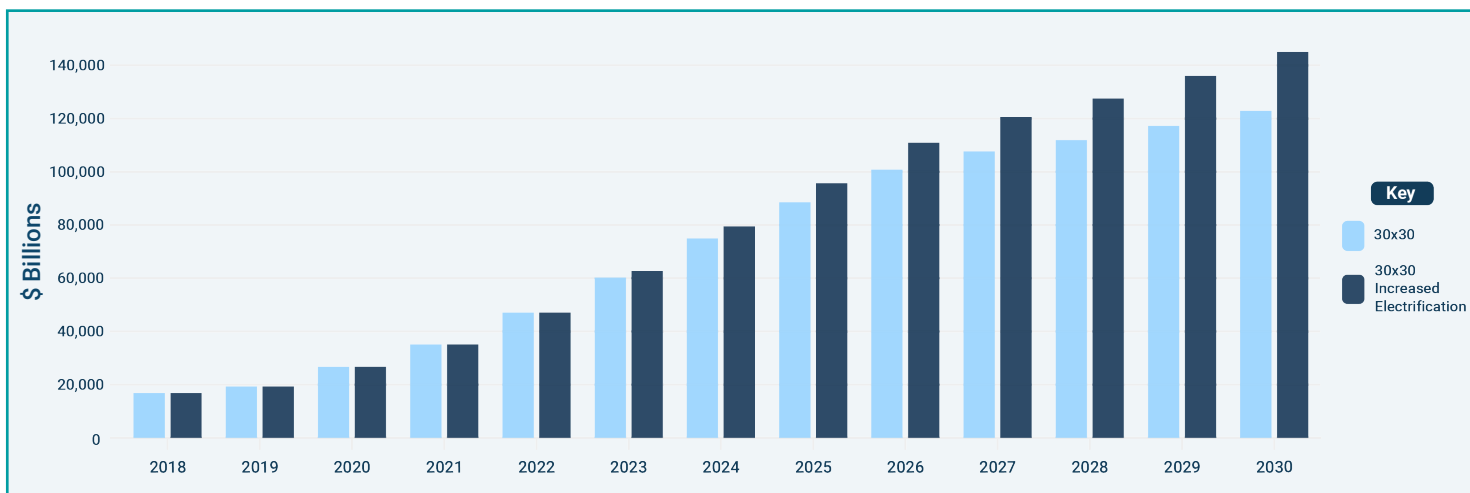
Federal legislation under consideration this year includes a ten-year extension of the ITC and also a direct pay option for the credit, which allows individuals and companies without tax exposure to get the equivalent of the tax credit in direct payment.

Our industry will need to be nimble over the Solar+ Decade to adapt to changing project finance dynamics, while remaining vigilant in our advocacy and defense of stable, long-term tax policies. Long-term policies support business certainty and the environment necessary for continued cost reduction and accelerated deployment. 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.

Even with these policies, the industry will need to expand access to capital. This could be through direct 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.

Figure 4: Annual U.S. Solar Industry Investment (\$ Billions) Under 30% by 2030 Scenario



State Policy 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, has been 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, Integrated Resource Planning 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.

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.⁶ 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.

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 15% 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 15% 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 implement 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.

As states further integrate their climate goals into the building, construction, and technology environments, the considerations of energy codes and building codes alignment is naturally involved. We will need to expand the technical services expertise resources (electrical, waste management, etc.) available to support our state policy resources to ensure alignment and avoid potential bottlenecks to achieve state-level goals.

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.

⁶SEIA/Wood Mackenzie Power & Renewables U.S. Solar Market Insight Q3 2019

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.

Previously, SEIA spearheaded 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.⁷ Only through sustained engagement by the industry with these organizations, including the American Clean

Power Association 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 must reflect these evolutions and must be flexible, fair, far and free⁸.

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 the table below⁹:

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

⁷Gramlich 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

⁸Id. at 3

⁹Id. at 5



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 installations¹⁰.

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.

At the implementation level, the industry must monitor the development of interconnection and integration standards, test protocols, compliance

evaluation guidelines, performance standards, and equipment certification requirements. This will ensure that wins established at the ISOs/RTOs levels are not unjustly burdened through deeper, engrained technology requirements that can potentially slow adoption of solar and storage as well as implement unfair performance or safety expectations.



SEIA and its members must make the pitch that to successfully transform our distribution system, competitive market providers cannot be shut out.

¹⁰O’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 30% 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, decommissioning, supply chains, recycling and workforce development, and these issues will only have a greater impact 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.

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.

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, the U.S. must scale up transmission upgrades and investments in the right places and support 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 30% 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.

Environmental Justice & Expanding Solar Access

Equity and environmental justice play a critical role in developing policies to advance clean energy goals and tackle climate change. The solutions we develop, at the local, state or federal level, to decarbonize our electricity system and transform our energy economy must take into account the disproportionate impacts felt by frontline communities. Intentionality is key – we can only achieve a just and equitable energy transition through focused policies that prioritize environmental justice and help build regenerative, sustainable wealth in local communities. In April 2021, SEIA released a comprehensive platform of policies and principles¹¹ that the clean energy industry should follow to incorporate these critical goals into our advocacy and strategies.

There are many pathways to progress on equity and justice for the clean energy transition, and all of them must be explored as we grow in the Solar+ Decade. These pathways include: providing career pathways to underserved communities and supporting a diverse pipeline of workers; expanding access to solar and storage to lower-income communities; leveraging government infrastructure and purchasing power to provide clean energy benefits to local communities; developing tax policies that remove financing barriers for distributed solar and storage; creating climate resilience and disaster response plans that include more deployment of onsite solar and energy storage; and establishing

siting and permitting process for large-scale clean energy projects that involve impacted communities.

Most importantly, these policy objectives and initiatives must be developed and executed in consultation with organizations and institutions that represent affected communities to ensure that they truly result in the intended outcomes of expanding access to clean energy and building a more diverse and inclusive industry. Working with community leaders and environmental justice advocates during each step of the policy process will ensure effective programs and incorporate the viewpoints and needs of those we are looking to serve and support. This collaborative work will require the industry to find common ground with broader equity and environmental justice goals to ensure we are true partners in this effort. We will need to grapple with complex and challenging issues that are indirectly relevant to energy equity and climate justice, including public health, voting rights, housing discrimination, and more.

The clean energy industry will also have to make progress on these objectives outside of policy action and government mandates. SEIA has developed multiple products and resources to help solar businesses increase diversity, equity and inclusion in their workforces and operations, including a certification program and database of diverse suppliers. SEIA will continue to work collaboratively with partners and members to work proactively on these solutions while advocating for public policies that catalyze further progress.

“
Scaling up distributed energy resources in low-income communities helps build wealth, promotes self-determination, and creates health benefits. These are all priorities of Environmental Justice.

¹¹<https://www.seia.org/research-resources/solar-industry-policy-principles-environmental-justice-equity>

International Trade

As solar has moved from a niche product 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 a final component or product. This increased reliance on imports has led to increased trade conflict.

Since 2012, solar and other renewable energy industries have experienced the adverse impact of U.S. tariffs, with nearly every solar article or major component 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 tens of thousands of lost American jobs.

While the solar safeguard tariffs have resulted in some new investments in U.S. solar module assembly capacity, other U.S. solar manufacturers have suffered. There is still a massive shortfall in modules for the utility-scale sector. 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 (see section on manufacturing).

One of SEIA's top priorities is ensuring a sustainable and ethical solar supply chain. When reports first emerged about potential links of forced labor in the solar supply chain, SEIA took several proactive steps to address forced labor

Manufacturing

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.

There is a robust racking manufacturing industry in the U.S. and enough domestic polysilicon capacity to support 20 GWdc of PV modules.

concerns. Examples include our Forced Labor Prevention Pledge and Traceability Protocol, which is specifically designed to provide U.S. Customs and Border Protection assurances that solar goods imported into the United States are free of forced labor. The critical next step is turning the Traceability Protocol into an ANSI-published industry standard.

To do so, SEIA must further develop more disciplined processes for convening members and stakeholders and can provide the basis for our qualification as an ANSI Standards Development Organization (SDO). As an SDO, we can publish standards against which manufacturers and other stakeholders can be suitably assessed, audited, evaluated, and named compliant and certified. Such certifications provide U.S. Customs & Border Protection (CBP) and other regulatory and legislative stakeholders assurance that industry takes seriously the testaments about our equipment and products being free from forced labor, conflict minerals and materials and other concerns.

SEIA also relaunched its Solar Commitment, a corporate social responsibility code, which defines expectations for solar industry participants. The Solar Commitment touches on topics like worker safety, environmental responsibility, ethics, and human rights. Given the extent of the tenets of the Solar Commitment, SEIA must work with partners, in addition to organically developing its own services where appropriate, to deliver process and solutions pathways for members and industry to not just aspire to the requirements, but to be in alignment and compliant with them.

In contrast, current U.S. PV module capacity is 7.3 GW¹² and there is no cell or wafer capacity. Disruptions during the COVID-19 pandemic and concerns over human rights abuses in the Xinjiang region in China have also highlighted significant vulnerabilities in our supply chains.

The Solar+ Decade therefore presents an enormous opportunity to dramatically expand solar manufacturing in the United States.

¹²SEIA/Wood Mackenzie Power & Renewables, U.S. Solar Market Insight Report 2021 Q3, available at: <https://www.seia.org/research-resources/solar-market-insight-report-2021-q3>

In 2020, SEIA announced a new target of 50 GW of annual domestic production capacity by 2030. While the United States does not need to produce every solar component and must continue work with allies in a competitive global market, meeting this goal will allow the United States to fill critical gaps in our supply chain, develop a robust domestic manufacturing ecosystem and create hundreds of thousands of jobs.

In 2019, SEIA hosted its first manufacturing summit which brought leaders in manufacturing from the public and private sectors to identify opportunities and challenges in domestic manufacturing. From the summit, SEIA published a whitepaper¹³ laying out our vision to expand the domestic renewable energy manufacturing base.

The whitepaper recognizes 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

Resiliency & Cybersecurity

Cybersecurity concerns will play an increasingly important role in the solar and storage 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 and storage 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 and storage continues to proliferate and expand across North America, the solar and

innovation ecosystem, including national labs and state incubators. Most importantly, the U.S. government must make long-term investments in manufacturing, including both supply and demand incentives.

SEIA has been advocating strongly for these policies at the federal level, and legislation under consideration in Congress includes several key incentives that will help foster a robust supply chain for solar products in the U.S. We must continue our advocacy for these targeted policies and work as an industry to develop a comprehensive manufacturing roadmap that can help inform project investment and facility siting decisions.

“Any efforts to support more domestic solar manufacturing must also include policies and funding for workforce training and education. They go hand in hand.”

storage 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.

¹³SEIA, The Solar+ Decade & American Renewable Energy Manufacturing, available at: <https://www.seia.org/research-resources/solar-decade-american-renewable-energy-manufacturing>

Consumer Protection

With more than three million residential systems installed to date, 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 has been working to ensure consumers, industry and government officials fully understand solar technology, transactions, rules and resolution options. The Committee 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. SEIA 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.

It is 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.



Workforce Development & Diversity

The long-term growth and success of the solar industry depends on a strong and diverse workforce. According to a recent survey of solar employers, more than 80 percent of respondents reported difficulty finding qualified job candidates¹⁴. To reach 30% of generation by 2030, our estimates show that more than 800,000 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.

In the short-term, the industry will need to immediately develop pathways to engage more skilled, training workers to available positions. General construction and tool-use knowledge can quicken the ability to train workers to install solar. Therefore, we will need to work with general construction workforce organizations and councils, both union and non-union, to identify and help funnel these early skilled workers to solar.

This effort also indicates the need for SEIA to provide an introductory, industry-developed overview course to alleviate the burden on solar employers to develop and deliver their own in-house or other external training that may be inconsistent with the dynamics of our industry.

Similarly, legislation under consideration in Congress involves requirements and tax incentives for apprenticeships in larger solar projects. To assist solar employers with connections to available apprentices, SEIA is developing workforce partners (both union and non-union) in existing and emerging solar markets.

We must also expand the reach of successful solar workforce development programs that have the potential to scale-up their geographical footprint and reach. Programs should offer a hands-on training component that is desirable for new installers and incorporate soft skills and job-readiness training.

SEIA has also embarked on an effort in partnership with the Interstate Renewable Energy Council (IREC) to develop a solar-based apprenticeship standard. This solar apprenticeship standard will enable industry to have an official solar installer occupation listed as apprenticeable. The standard can then be used by workforce organizations, solar employers, unions, non-unions, and others to develop in-house apprenticeship programs specifically for solar installation like already exists for electricians, plumbers, and other contractors.

“ We can’t just go and tell people that we are the solar industry and we want them to join us. We have to listen, too. We have to listen to people of color, women, immigrants, low-income communities to hear what they need and how best to reach them. ”

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

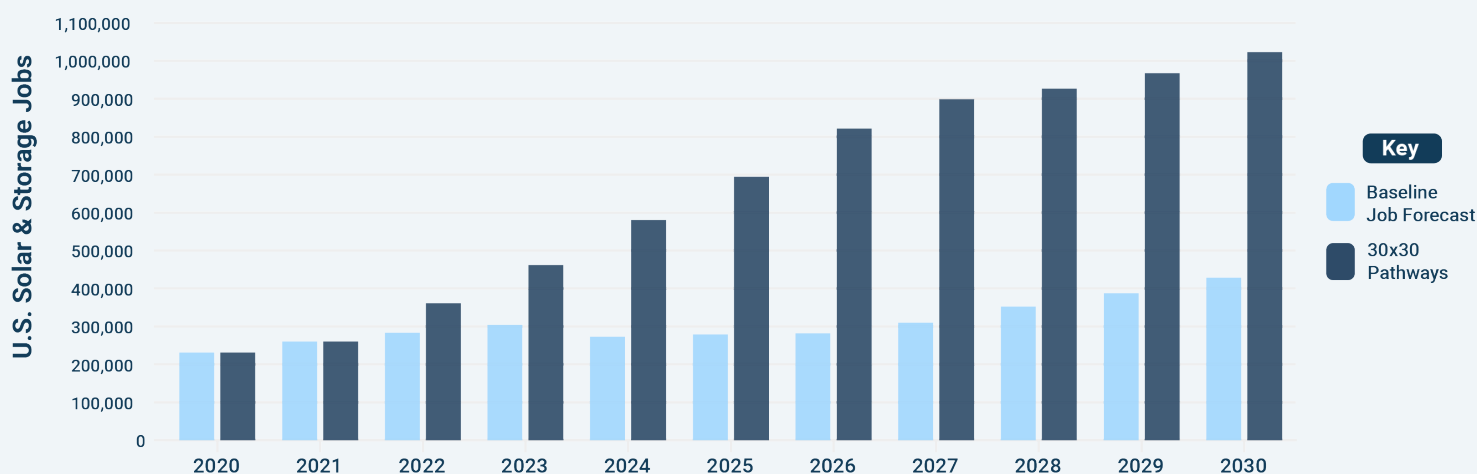
In addition to addressing the short-term shortage of available, skilled solar workers, we must also build out our pathway for future solar industry career participants. SEIA must perform outreach and program development with secondary schools, trade/vocational schools, and programs, and showcase the early-career consideration into solar energy. These organizations, schools, and training programs may include union, non-union/merit, and other occupations programs (such as high-school regional occupational programs that provide internships and volunteer opportunity to future culinary arts, nursing, and trades students). This will enable us to put our environmental goals and objectives in front of these students, and detail how these early career seekers can be part of that overall effort.

Long-term, the solar industry needs to scale-up our engagement with consumers and families

such that our clean, renewable, electricity-generating prowess is not just the topic of elementary school science fairs or a few pages in a textbook or science module. Increased engagement with elementary and early secondary schools to present solar as ubiquitous as first responders, engineering, or medical fields as great career choices can no longer be delayed.

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 6: Solar Industry Workforce Path to 30% by 2030



Land Use

Getting to 30% 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 efficiency improvements and ensuring solar projects provide ecosystem services. 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 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 responsibility for being good stewards of the land and build community support for each of our projects. Taking lessons from other energy industries, we can identify methods for building that support.

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.

“The solar industry doesn’t do a good enough job telling the good stories about community impact. We have the benefit of being on the right side of history, all we have to do is stop playing defense and talk about the positive impact of solar projects on the land and on the communities where we work.”



¹⁵Delivering through Diversity, January 2018, McKinsey & Company, available at: https://www.mckinsey.com/~/_media/McKinsey/Business%20Functions/Organization/Our%20Insights/Delivering%20through%20diversity/Delivering-through-diversity_full-report.ashx

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

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. SEIA began an initiative to assess the strategies and channels for end-of-life management more than five years ago, which led to the development of PV recycling resources across the nation.

With more than 500 gigawatts (GWdc) of photovoltaic (PV) modules installed globally¹⁷ (including more than 100 GWdc in the U.S.), 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, thereby maximizing its overall use and potential.

However, absent industry-endorsed guidelines or procedures for properly and safely assessing the potential for reuse or refurbishment, those activities have been largely entrepreneurial and low-volume, similar to other ‘vintage’ markets. SEIA has discussed development of these guidelines with Nationally Recognized Test Laboratories but the perceived lack of a current market to serve remains a challenge.

Looking, therefore, more closely at recycling as a short-term, immediate solution, SEIA has mainly relied upon its influence with its members, which include many of the top global manufacturers, developers, owners, and O&M companies, to seek recycling solutions for those products over landfilling despite the ‘raw’ cost savings that landfilling might present. A recent Nature Energy

article summarized a Julian Walzberg/NREL study, “Role of Social Factors in Success of Solar Photovoltaic Reuse and Recycle Programs” and stated that peer influence, consumer preferences, and other social factors can influence the preference for recycling and reuse where the economics aren't attractive. SEIA must more assertively convince industry that recycling (along with reuse and refurbishment when better positioned) is the preferred method for equipment disposal over landfilling. This is also addressed in the refreshed Solar Commitment and will help proactively show legislators that industry is indeed acting responsibly and does not need to be ‘forced’ to do so through legislation.

The other components of solar systems can also be handled responsibly. Inverters can be recycled in existing e-waste and industrial equipment recycling streams, racking equipment can be re-utilized with newer technology or recycled like other scrap metals, and copper or other wiring can be suitably recycled or reclaimed. 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. While silver is less used in PV modules manufactured today, the legacy PV modules installed over the last decade could present an attractive reclamation value when recycled.

¹⁷NREL, Q4 2018/Q1 2019 Solar Industry Update <https://www.nrel.gov/docs/fy19osti/73992.pdf>

Overall, current recycling methods are mainly mechanically-based in the U.S., where shredding, crushing, or other methods are used to physically separate components before other filtering methods are employed. Outside the U.S., however, there is more considerable innovation on PV module recycling equipment that can lead to higher-efficiency recycling and material reclamation. Similarly, some start-ups and entrepreneurs in the U.S. are working with universities and research institutes to develop successful material procedures at lab-scale.

Lastly, the controversy regarding toxicity of PV module materials and components is often misrepresented and misused by solar opponents. SEIA, its members, and industry should embark on a more well-informed communications campaign to assure consumers and stakeholders that our products are safe during operation and when handled properly, are safe to dispose of through recycling or other sustainable means.



Photo courtesy of Swinerton Renewable Energy

¹⁸<https://www.seia.org/initiatives/seia-national-pv-recycling-program>

Achievability

While the 30% 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. Failure to move quickly and decisively will result in significant adverse consequences for addressing climate change, and will leave billions of dollars in private investment and hundreds of thousands of new career opportunities on the table.

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 3 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 30% 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.

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/30x30



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