It's Always Sunny in America: Renewable Energy Policy and the Solar Economy

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Abstract

Renewable energy, especially solar, has become increasingly popular over the past two decades. It is clear that the United States must take a stand to decrease carbon emissions and its related impact on the environment and climate change. What is not clear, however, is whether this increase in popularity has been due to policies implemented by the government or more traditionally market supply and demand. Taking a broad historical approach I examine relevant renewable energy policies since 1978 and the impact these polices have had on fostering the solar energy market. I argue that that favorable renewable energy policies have allowed for the creation of the current solar energy economy. For this to be true, I would expect to see the fastest growth in the solar energy market on the tail of favorable policies. This thesis has found numerical and anecdotal evidence showing that there is a connection between federal policies and growth-promoting investments in solar energy. I therefore conclude by providing policy recommendations to keep the solar economy growing in a similar fashion.

Introduction

In 2015 *Planet Money*, a podcast produced by NPR interviewed John O'Hagan, a retired New York City cop about the solar panels on his house. O'Hagan was not putting the panels on his roof to save the environment. His choice was not moral, progressive or trendy. John O'Hagan was switching to solar because it was cheap (Goldstein).[1]

[1] Listening to this podcast inspired my first academic paper on solar panels for Dr. Petryna's Cultures of Science and Technology class at the University of Pennsylvania. Much of that work became the basis for this study, as the paper I wrote for her class was essentially the proposal for this paper. See the Works Cited for more information

Since 2008, the price of solar energy has dropped dramatically. More and more people like John O'Hagan are moving towards renewable energy than ever before. Being green is no longer reserved for the wealthy. This leads to an interesting puzzle – how can something that was so unreachable by so many before become commonplace within the term of one president.

Every year it is increasingly clear that something has to be done about our environmental impact. Out of the fifteen hottest years on record, only one (1998) occurred before 2000. Last year, 2015, was the hottest year on record and saw a large number of natural disasters including an Eastern North Pacific Hurricane season that was 144% of the normal average activity, severe flooding in China and a heat wave in India that causes more than two-thousand deaths ("Annual 2015"). Luckily, we do not have to choose between the environment and the economy (Hinman). Throughout the remainder of this study I aim to answer one question. What is the impact of renewable energy policies on the solar economy?[2] Obama has made it clear throughout his term that building the green economy, including the solar industry, is an important step our country must take, with benefits to both the environment and the economy at large. Bills such as the American Recovery and Reinvestment Act of 2009, the Clean Energy and Security Act of 2009, and Renewable Energy for America of 2014 display this administration's dedication to clean energy and show potential for growing the American economy. Solar is key to the success of this mission. Since George W Bush's Investment Tax Credit began to lower the personal cost of going solar, this particular form of energy has

[2] The solar economy is an integral part of the green economy, which Elsie Harper-Anderson explains "is achieved by creating regulations, standards, investments and incentives that stimulate production and economic activity broadly aimed at decreasing environmental degradation via either the ways goods and services are produced or the kind of products that are produced and used" (Harper-Anderson 162).

boomed – illustrating that the industry is an important one that needs to continue to be fostered.

My study will take the following format.[3] First, I will provide details about the solar energy industry as it stands now, including its benefits, challenges and potential for growth. Then, I will discuss policies past and present that have affected the solar energy economy. I will conclude by illustrating policy recommendations that would help the solar industry to boom, benefiting both the environment and our economy.

The United States Solar Industry: Benefits, Challenges, and Potential

Solar Energy – An Introduction

Solar energy production can be both residential and commercial. First, the residential level - if someone says "solar panels", it likely conjures a mental image of a house with shiny rectangular panels on its roof. Indeed, this is a common way for an individual to become largely (if not entirely) independent of the fossil-fuel driven utilities. Due to their increase in popularity, there are now multiple installers of solar panels, so individuals can shop around and decide which company works best. Solar panels, therefore, are a perfect example of an environmental fix that works with capitalism – an increase in demand has created a workable market.

One well-known solar panel company is SolarCity, the brainchild Elon Musk and two of his cousins ("SolarCity Claims"). *Computer World* reporter Lucus Mearian chose SolarCity[4] for his own house because the panels have a lower profile than other companies and have a drip

[3] I was deeply inspired by Jeffry S. Hinman's "The Green Economic Recovery: Wind Energy Tax Policy After the Financial Crisis and the American Recovery and Reinvestment Tax Act of 2009" – a paper that fell on my lap when I was struggling to pull all of my research together into a cohesive piece. I have therefore borrowed from his format heavily and hope that my research can act as a compliment to his.

[4] Solar City also assigns each customer a representative to provide some handholding and information. They are also looking to pitch to neighbors and will likely ask to put a sign on your front year. ("My Big Fat Installation")

edge, along with having the best price and an efficiency guarantee at the time of his purchase. In one of his many articles about solar energy, he explains,

> "I locked in a price of 12.5 cents per kilowatt of power I use, plus an annual increase of 2.9% over 20 years; that works out to about a 1 penny per kilowatt increase every three years .By comparison, my power utility (Eversource, formerly NSTAR) was charging me 13.3 cents per kilowatt and an additional 10 cents delivery charge. The utility had also raised its rates by nearly 60% last January, a relatively common practice these days among utilities." ("My Big Fat Installation")

No matter what company an individual uses, however, the process is fairly straightforward. It begins with a free quote that focuses on current energy use and the results of satellite images which determine if the roof gets enough sunlight or if it is blocked by too many trees. Then, designing software is used to determine how much energy will be produced by a variety of panel configurations. After all of that, the homeowner must decide if they want to buy or lease the panels. Leasing is extremely popular right now because there are no upfront costs and you have a partner with a vested interest in keeping the panels working. Buying, on the other hand, will allow for a greater return on one's investment (10-12 years). Next, an inspection is carried out to determine the roof is solid enough, the panels will get enough sunlight and that the electrical panel is compatible. Once passing the inspection, it is finally

time for installation.[5]Post installation it will take a few weeks to a few months before the homeowner will begin to see benefits as the utility has to install a revenue grade meter that can feed power back to the grid.

For individuals who do not own their home or do not live in an area where solar panels make sense (a wooded neighborhood, for example), there is a way to get in on the solar market.[6] Community solar farms are simply a collective that individuals can buy into, the more people that buy in the more successful the solar farm is ("My Big Fat Installation"). By buying in, you are helping to fund the creation and upkeep of the farm in return for a portion of the energy it creates. If something happens to the panels, individuals in the collective can still get power from local utilities by paying the traditional rate ("My Big Fat Installation").[7]

There are at least 52 community farms in the United States and this number is only growing ("Community Solar"). According to GTM research, community solar represents the next largest solar market. It is expected to increase seven-fold over the next two years, growing 500% this year in the United States alone. By 2020, community solar could be expanding by half a billion watts each year ("Obama, Sanders"). Right now Arizona, California[8], and Massachusetts

[5] Before installation can begin, the solar company must get permits from local building departments. Once these are obtained, the installation can begin. A 6.2 kilowatt system will take, on average, 4-5 people about 5 hours of crawling on your roof to install. Then, a licensed electrician will install an inverter box near the electric panel (either inside or outside) to turn DC output from the panels into AC which can then be fed into the commercial grid or used to power your house off-grid. ("My Big Fat Installation")

[6] This is also a great option for the close to 10% of people surveyed that listed "ugly" as one of the top words that came to their mind when asked about solar panels.

[7] Right now, Clean Energy Collective (CEC) and SunShare are community solar market leaders, holding 32% combined market share. Like most collectives, these work by partnering with utilities to create high-volume, one-off community solar projects ("Community Solar").

[8] California is about to implement two community solar projects which will add about 600MW of capacity by 2019 (110.5MW by 2016). One project is third-party led while the other is actually run by the utility company ("Community Solar").

have the highest community solar capacity, but at least ten states are considering legislation to promote alternative energy in this way.

It is also useful to have a working understanding of the science of photovoltaic (PV) panels. A solar panel is made up of a bunch of small units called photovoltaic cells – meaning cells that convert sunlight to electricity. These cells are made up of two pieces of semi-conducting material such as silicon, one with a negative charge and the other with a positive charge. The panels require an electric field to work and the opposing charges create such a field. PV cells allow particles of light, called photons, to knock electrons from atoms, creating a flow of electricity (Dhar).

There are different types of solar panels in production now, but most use the PV cell technology. This technology is not the most effective and panels are often rendered even less effective by the placement of the cells or the panels themselves. However, scientists and engineers are working to make panels more efficient every day. For example, Joshua Pearce from Michigan Technological University figured out a way to have more sun hit solar panels, increasing electric output by more than 30% just by adding reflectors to panels (Mills).[9]

Environmental Benefits of Solar

Every day more than 2,500 times the sunlight needed to produce the energy consumed by Americans hits the United States – unlike fossil fuels, this energy resource is not disappearing anytime soon (Chandler). However, besides being sustainable, how is solar good

[9] In October 2015, SolarCity claimed to have created the world's most efficient rooftop panel, coming in with a 22% efficiency (the average is 15%). These panels will create up to 40% more electric output while costing the same as traditional panels to produce, about 0.55 cents per watt. Each panel has a 355 watt capacity and performs better at high temperatures, allowing for more energy production. Right now the panels are in test production at their 100MW plant in Fremont, CA and will move to mass production at the 1GW facility in Buffalo, NY, which is scheduled to be at full capacity in early 2017. At full capacity the Buffalo Plant is expected to produce up to 10,000 solar panels a day. SunPower, another brand, comes in second place with 21.5% efficiency ("SolarCity Claims").

for the environment? The most obvious and largest advantage of using solar energy production over traditional methods is reduced carbon dioxide emission (Tsoutsos). Currently, most the energy that modern society relies on is produced by burning oil and coal, both forms of fossil fuel that shoot emissions into the atmosphere (Chandler). According to scientific consensus, carbon emissions will lead to a warming of at least several degrees Celsius by 2100 if left unmitigated at the most conservative estimates. These increases could result in high-impact local, regional and global risks to human society and natural ecosystems. Additionally, anthropogenic increases in carbon dioxide will have affects that go beyond 2100 as carbon can remain in the atmosphere for hundreds of thousands of years (Clark).

Additionally, solar energy has lower levels of NOx, SO2 and particulates (Tsoutsos). Beyond lower levels of greenhouse gas emissions, using solar energy over fossil fuels can improve water resource quality, lead to the reclamation of degraded land and reduce the amount of land needed for transmission lines connected for energy grids (Tsoutsos). And an added bonus? Solar production is at highest just when demand strikes in the summer (Chandler).

Economic Benefits of Solar

Jobs and Economic Activity

Due to favorable policies in the United States, America is now the fifth most attractive nation for manufacturing solar panels (“U.S. a Top Destination”). Add in all of the jobs created by companies that market and install panels and you get a massive amount of job creation. Last year, the solar industry added 31,000 new jobs, twenty times the national average (“Obama, Sanders”). In 2014, the solar installation industry added about 50% more jobs than both the oil

and gas pipeline construction industry and the crude petroleum and natural gas extraction industry ("Solar Industry Jobs"). Job creation represents another benefit for the poorest of Americans. Not only does the proliferation of solar panels mean cheaper utilities for low-income Americans and fewer consequences of climate change, but there are now more opportunities to make a living wage.

Competitiveness with Traditional Power Plants

Solar energy has exploded in recent years. So much so that it has gained powerful enemies – such as the Koch brothers. "Big Solar" represents a large enough threat to companies that profit from burning fossil fuels that investor-owned utilities and organizations like the Koch brothers' American Legislative Exchange Council are fighting this form of renewable energy on the state level. The pushback has been especially bad in Florida, a state with the third-best rooftop solar potential in the United States and the best solarity east of the Mississippi. The work of anti-solar lobbyists has pushed the state to sixteenth in the nation in solar production, lagging behind even New Jersey and Massachusetts (Dickinson). Why does solar pose such a threat? As put by one author, "The rise of cheap, distributed solar power poses a disruptive – and perhaps existential – threat to the traditional electric utility business (Dickinson).

This poses another question – how? The same *Rolling Stone* article provides three main ways in which solar threatens the monopoly gains made by investor-owned utilities (IOUs). For starters, IOUs make a lot of their profit by building infrastructure. However, utilities need fewer power plants when homeowners install their own panels, destroying opportunities for IOUs to profit. Perhaps more obvious, solar homes also buy less electricity from the grid. Finally, new

net metering laws force many utilities to pay panel owners for the power the produced but do not use (Dickinson).

Security Benefits of Solar

Pew Charitable Trust states on their website that "[America's national security is tied directly to energy consumption and global climate change" ("Clean Energy Is Patriotic"). This statement represents a benefit of solar energy that theoretically both sides of the aisle should be able to get behind – national security.

Extreme Weather

Events like Hurricane Sandy and Hurricane Katrina have shown the United States the extreme danger and cost of extreme weather. Intense storms, draughts, and floods can cause major national security risks. Not only do these storms cause death, injury and loss of property, but they also increase demand on federal funding by means of relief and National Guard deployment. Additionally, extreme weather can alter agricultural patters. Perhaps most importantly, however, extreme weather can cause instability at home and abroad, deeply threatening national security ("Clean Energy Is Patriotic").

Foreign Oil Dependence

As mentioned before, most energy comes from the burning of fossil fuel like oil. In fact, the United States is the largest petroleum consumer. In 2012, 40% of the petroleum consumed by the United States was imported with 28% from Canada, 13% from Saudi Arabia, 10% from Mexico, 9% from Venezuela and 5% from Russia ("Energy In Brief"). This poses a threat to national security for a few reasons. First, it gives other countries a bargaining chip and can bring the United States into conflicts we otherwise would not be concerned. Second, it removes

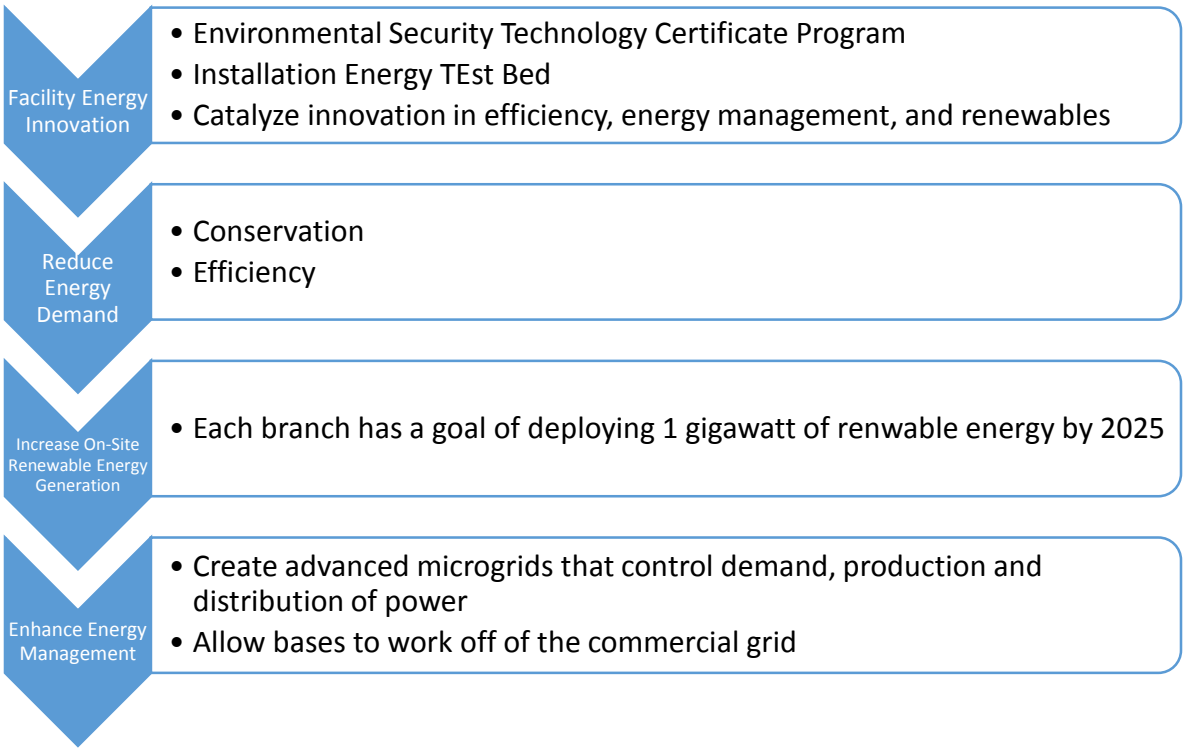
wealth from the United States and sends it abroad. Finally, we rely on other countries in order to fuel our everyday lives, including hospitals, schools, and government property. While American dependence on foreign petroleum has declined since peaking in 2005, the United States is still not capable of fully powering itself. Solar, and other forms of renewable energy, could be the answer to this problem. By increasing America's solar capacity, the country could continue to wean itself off of foreign oil. Consequently, the Obama administration also sees the importance of reducing oil dependency. In 2012 Obama announced a goal to reduce oil imports in half by 2012 (Furman).

Military Operations

Perhaps the best illustration of the connection between solar power and national security is the focus that the United States military is putting on clean energy. The United States Department of Defense states the following, "[energy security is] the ability to assure access to reliable sources of energy and deliver that power to meet operational needs on [DOD] bases in the United States and Abroad". In short, it is a major military objective to have safe, secure, uninterrupted and affordable power available for the United States military at all times (*Power Surge* 1). For a variety of reasons, energy security is now considered a topline priority for the DOD. This security is needed for mission assurance – communication centers, bases and other centers of DOD life need to have energy at all times to insure that their missions can be carried out in a timely, safe manner. Also, cost savings are important to the DOD as budgets have been slashed in recent years. By converting to renewable sources, the DOD is able to stick to their budget and save tax payers money. Finally, the DOD has to comply with laws passed by congress, executive orders, and the goals of military leaders. For example, there is currently a

requirement to reduce facility energy used per gross square foot by 3% annually and for 25% of energy production and procurement to be from renewable sources by 2050 (*Power Surge* 2).

The branches of the United States Military – Army, Navy, Air Force, and Marines – have a four part Master Energy Performance Plan in place to ensure their short and long term progress in energy security. Due to the success of this plan, it is worth examining and learning from for a wider policy perspective.



The military's work is especially relevant because solar constitutes the second-largest component of their deployed renewable energy providing 125.5 MW of capacity, which is 33% of all renewable capacity through the DOD (*Power Surge* 26). Geothermal is currently at the top

with a 170MW capacity, however if the DOD hits its goal of reaching 945MW of solar capacity by 2018, solar will take its place (*Power Surge* 28).[10]

Challenges for the Solar Energy Industry

State and Federal Politics

One of the major challenges facing the solar industry is political. Lawmakers are currently facing three major concerns when determining policies regarding solar power. First, net metering poses a problem. Policy makers have to find a balance between keeping the consumer and the producers of solar panels happy as they decide how much solar generated power utilities have to buy back. In Nevada, SolarCity began to struggle when the state legislature decided to cut back its net metering program following Elon Musk's loss to Warren Buffet in a regulatory battle. SolarCity's stock devalued by $165 million in one day after this, especially because net metering is one of the biggest factors that makes rooftop solar financially wise for consumers (Follett). SolarCity ultimately left Nevada after this decision ("Battles Over Net Metering").

Those who disagree with net metering argue that the policy transfers unfair costs to non-panel owners. However, it is not clear if that is true. A study carried out for the Nevada Public Utilities Commission found that between 2004 and 2016, net metering for installed systems would save non-panel owners around $36 million over the life of the systems ("Battles Over Net Metering"). Despite these, and other, questions over the cost of net-metering to non-

[10] A variety of exciting projects are helping the DOD to reach their goals. The Air Force Academy, for example, has a 6 MW solar array that saves $1 million annually and meets 11% of the school's needs (*Power Surge* 15). Davis-Monthan Air Force Base started building a 14.5 MW array in June 2013 that will save $500,000 annually and provide 35% of the base's needs. Davis-Monthan already has a 6 MW solar capacity, so they will end up with over 20 MW of solar capacity (*Power Surge* 15). Fort Bliss, however, is the most exciting. They are currently working to become the army's first net zero facility by 2018.

panel owners, most major solar markets are facing challenges to net metering, including California and Arizona. In Mississippi, it was decided to pay wholesale rates for solar produced by homes and small businesses instead of the traditional retail rates and Hawaii closes down its solar program in October. It is worth mentioning that many states are either at or near the total solar capacity allowed under their net metering programs to begin with. This means that any new residential installations will not be included under net metering programs to anyway[11] ("Battles Over Net Metering").

Luckily it is not all bad news concerning the net metering problem. Some states are finding ways to compromise or work around previous policies. For example, in October 2015 New York State decided to suspend its cap on solar photo-voltaic systems covered by its net metering program. New Mexico is also fighting back against utilities. The state recently dismissed a proposal by El Paso Electric to impose fees on solar panel owners ("Battles Over Net Metering").

Second, solar credits are becoming more confusing. Many policies require utilities to obtain a certain amount of energy from renewable sources. As solar becomes more popular, it is unclear wheatear the energy bought from residential panel owners should count toward the required amount of renewable energy utilities must buy annually (Chesto).

Finally, balancing federal and state policies is becoming more important. It is crucial for state officials to keep policies favorable to solar in order to keep companies building in their state. On top of that, sometimes various policies and decisions get in the way of other ones. For example, the Supreme Court recently stayed the Clean Power Plan (CPP) which aimed to reduce

[11] Nevada maxed out its 235 MW net metering program in 2015 ("Battles Over Net Metering")

carbon dioxide emissions from power plants 32% by 2030. The court became concerned about the Environmental Protection Agency's plans to implement the CPP after twenty-nine states sued, believing the policy would cripple the coal industry. They argued that the bill double-regulates coal-fired plants as they are already regulated by the Clean Air Act. Additionally, states also feel as though the federal government is taking over their energy policies. In June 2016 the Obama administration will have the opportunity to defend the Clean Power Plan. They will likely argue that striking down the CCP will go against the commitments the United States made to the international community in December 2015 at the United Nations Climate Change Conference in Paris. At the conference Obama pledged to cut emissions by 26% to 28% by 2025; two-hundred other countries made similar pledges. Despite popular support for the conference – 60% of Americans supported an international treaty requiring signatories to reduce carbon emissions going into the conference - Obama's commitments have not yet been ratified by the United States Congress (Bastasch).

Environmental

There are also some environmental challenges. While the environmental benefits from solar are straightforward (smaller carbon footprint, clean energy source, etc.), the downfalls are harder to see. Panels still are not as efficient as they could be and their production uses lots of energy and creates waste. Additionally, there is some research that shows that solar panels can cause some local changes in weather patterns due to disruptions in normal solar radiation patterns. However, the benefits still outweigh the consequences of these changes (Chen).

International

China represents its own mess of problems, problems that could be seen in the United States without proper regulation. Not only is China the largest consumer of solar energy, but it is also the largest producer of solar panels. With the recent uptick of solar, the risk for major pollution problems has increased. When PV panels are produced silicon tetrachloride and hydrochloric acid, both dangerous materials, are produced. Usually, these materials are disposed of in a way that makes them less problematic. However, in China about two-thirds of solar manufacturing firms are not meeting standards for environmental protection or energy consumption. Non-compliance includes wasting energy, the careless disposal of used solar panel equipment (including batteries) and poor byproduct waste treatment[12]. Luckily, the situation is not hopeless. With better waste treatment, environmental monitoring and education, the bad effects of a valuable sustainable technology can be mitigated (Yang).[13] Therefore, solar should still be considered a valuable form of renewable energy.

Room for Growth

The statistics surrounding the proliferation of solar panels in America are exhaustive. In the United States, the total photovoltaic capacity was only about 0.7GW in 2007. Only 5 years later in 2012, the capacity reached 7.1GW[14]. This number rose to 21.3GW in 2015 – enough to power 4.3 million homes - and is estimated to hit 58GW in 2017 ("Obama, Sanders"). There was twenty times more solar power produced in 2015 than when Obama first took office in 2008

[12] In 2011, an area of the Mujiaqia River near a solar panel factory had fluoride levels ten times higher than permitted. This not only killed local wildlife, but also posed significant health risks for nearby residents (Yang).
[13] Problems like this happen everywhere, China is just the worst offender
[14] Interesting note – 1 GW is equal to the energy produced by a large gas or nuclear plant (Fehrenbacher).

("Obama, Sanders"). In 2014 the United States brought as much solar energy online every three weeks as it did in the entirety of 2008 ("FACT SHEET").

The massive growth of the solar market is expected to continue into 2016. Favorable policies in the United States and China are leading to predictions for drastic increases for the first half of the new year. In the United States, it is expected that 16.82GW will be produced in the first quarter of 2016 and 17.73 in the second quarter. Additionally, China is expected to announce a new high panel quota. (Fehrenbacher).

It is not just the United States – China and Japan are largest international consumers of solar ("U.S. a Top Destination"). The United States is currently third for PV market share at about 14% and Europe is starting to grow again after a decline from its dominant spot from 2004 to 2011. Experts expect Europe's market to bottom out in 2015 at 21% of the market and start growing again in 2016, installing 42GW by 2020 to 31% of the market. Even emerging markets are growing. Latin America, Africa, and the Middle East, historically hovering around 1% of the market, are expected to grow to 17% of the demand over the next five years ("Community Solar").

It is clear that solar is growing, especially in the United States, but what does that growth mean? Today, the United States gets about 0.4% of its energy from photovoltaic cells. Comparatively, 39% of U.S. energy is from coal, 27% from natural gas, 19% from nuclear, 6% hydroelectric, 4.4% wind, 1.7% biomass and 0.4% geothermal ("Clinton"). Those numbers may seem small, and they are, however they are in prime position to grow as the above numbers show. The United States Energy Information Administration expects that utility scale solar will increase by 90% going into 2017 and that half of that capacity will be in California alone.

Additionally, it is estimated that solar will count for half of new electricity capacity out to 2020. There is even more potential beyond that. In order to power the entire United States, only 0.6% of the countries land area would need to be covered with PV panels, about 1,948 square feet per person. Since panels are becoming more and more efficient, that number could go down in the near future ("Clinton"). In other words, solar is going to grow while other forms of energy will likely remain fairly stagnant. Unlike coal and natural gas, we are nowhere near tapping the full potential of solar energy.

A variety of indicators that point to continued growth for solar in the United States. It is becoming clear that the country has reached an inflection point when it comes to public opinion about solar. When asked about various forms of energy, 79% of Americans wanted more emphasis on solar power – a percentage that is growing in the right direction (Riffkin).

Percentage of Americans Favoring More U.S. Emphasis on Various Energy Sources, 2013 vs. 2015

Do you think that as a country, the United States should put more emphasis, less emphasis or about the same emphasis as it does now on producing domestic energy from each of the following sources -- [RANDOM ORDER]?

	More emphasis 2013	More emphasis 2015	Difference
	%	%	(pct. pts.)
Solar power	76	79	+3
Wind	71	70	-1
Natural gas	65	55	-10
Oil	46	41	-5
Nuclear power	37	35	-2
Coal	31	28	-3

March 5-8, 2015

GALLUP

This increase in support for solar comes alongside with increasing public opinion regarding the importance of climate change. In 2015, 53% of Americans stated that global warming is caused by human activity, up from 42% in 2011. At the same time, half of Americans asked stated that global warming is an environmental problem that is having a serious impact now, up twelve points from 2010. The numbers go on and on – 63% of Americans favor limiting the carbon emissions from United States power plants, 55% are willing to pay more for electricity produced by renewable sources and 54% believe that protecting the environment is more important than stimulating the economy (Salvanto).

There is also increased corporate support for solar – which many arguing that the recent climate conference in Paris is behind. More than half of the world's largest companies now support steps to cut emissions and a third support putting a price on carbon. Additionally, more than 55% of companies report generating some electricity on site, 13% of which is solar or wind (Koch).

Finally, politicians are stepping in to provide extra support for the solar industry. For example, Andrew Cuomo, the governor of New York, announced in January 2016 that his state will spend five billion dollars over a decade on clean energy. Other states have set specific long term goals for increasing their renewable portfolios. Hawaii has pledged to get all of its power from renewables by 2045. Slightly less radical, California has promised to reach 50% capacity by 2030. Up north, Vermont has pledged to get 75% of its energy from renewables by 2032 (Koch). While each state obviously plays a part, the federal government arguably has more power when it comes to pushing the United States towards renewable energy. For the remainder of

this study, I will discuss federal policies that have impacted the solar energy economy from 1978 until now.

Past and Present Federal Support for Renewable Energy

The Past: Jimmy Carter to George W. Bush

Renewable energy may seem like a new fad and solar panels have just taken off in the past decade, but the thirty years leading up to the Obama administration set the stage for the current state of energy affairs.[15]

The National Energy Act (1978)

In the 1970s the United States faced an energy crisis – a fossil fuel price spike caused economic strife and the OPEC Embargo of 1973 followed closely by the Iranian Revolution in 1979 illustrated American vulnerability due to a dependence on foreign oil (Hinman 47). In this context, the National Energy Act of 1978 (NEA) was brought to force. This five part act should be viewed as the founding father of renewable energy policy – the Energy Tax Act of 1978, Public Utility Regulatory Policies Act of 1978 and the National Energy Conservation Policy Act being most relevant to the solar economy.

The National Energy Conservation Policy Act (NECPA)

The National Energy Conservation Policy Act represents a broad mix of policies aimed at decreasing energy consumption in America. It replaced the Minimum Energy Performance Standards (MEPS) created by the Energy Policy and Conservation Act of 1975 (Hinman 47) and made energy standards mandatory. NECPA also required energy audits to be done by all federal

[15] I will here discuss only the bills relevant to solar energy. Numerous other bills regarding renewables and sustainable energy in general have be enacted since 1978, however I found them to be outside the scope of this project.

agencies. Finally, similar to the energy bills popular today, NECPA set up loans and grants for renewable energy projects. Loans were made available for families that wanted to purchase solar heating or cooling systems for their homes. On top of that, grants were established for schools, hospitals, local governments and public housing authorities that were interested in using energy conservation measures ("History of Major Energy Policy Landmarks").

Power Plan and Industrial Fuel Use Act

The Power Plan and Industrial Fuel Use Act mainly worked to restrict the amount of fuel used industrially. I limited the use of oil and natural gas in industrial boilers and curbed the construction of power plants fueled primarily by natural gas or oil. The Power Plan and Industrial Fuel Use Act was ultimately repealed in 1987 by the Natural Gas Utilization Act ("History of Major Energy Policy Landmarks").

National Gas Policy Act

The National Gas Policy Act should be seen as a direct response to the fuel crises of the 1970s. It provided authority to high priority users during supply emergencies, created rules for allocating high-cost gas to industrial consumers and also set up wellhead pricing maximums. The act also gave Federal Energy Regulatory Commission (FERC) jurisdiction over the majority of natural gas production ("History of Major Energy Policy Landmarks").

Energy Tax Act of 1978 (ETA)

The Energy Tax Act of 1978 was important for setting up a strong renewable economy because it provided financial incentives (and disincentives) to promote using renewable methods of energy production. Many of the incentives came in the form of tax incentives. There were tax credits for new investment in renewable energy technology and renewable energy producing facilities (Hinman 48). The ETA took an existing 10% business investment tax

credit (ITC) that had been enacted in 1962 and expanded it so that business investments pertaining the renewable and nontraditional energy facilities were eligible for an additional 10%. This, and all ITCs, is important because it effectively lowers the initial cost of purchasing and increases the rate of return to the investor (Hinman 49). On a more individual level the bill provided for income tax credits to be awarded to citizens for using solar, wind or geothermal energy sources at home ("History of Major Energy Policy Landmarks"). In terms of disincentives, the ETA reduced subsidies and tax deductions that favored the production of oil and gas. These benefits had created a windfall of profits for companies benefiting from the rising oil prices (Hinman 48). The ETA also set up the Gas Guzzler Tax for vehicles with gas mileage under specified levels ("History of Major Energy Policy Landmarks"). Sadly, Ronald Reagan hated government intervention in energy markets. As a result, both the general business ITC and the energy ITC were allowed to expire in 1985 (Hinman 53).

Public Utility Regulatory Policies Act of 1978 (PURPA)

Net metering can be considered the great grandchild of the Public Utility Regulatory Policies Act of 1978, which required utilities to purchase all of the power generated by independent owned renewable energy plants at a price equal to the utilities avoided cost, or the price that would have been expended to meet the same energy need (Hinman 49). In this way, PURPA was important as it broke up the monopoly held by the electric utilities and ensured a fair price for renewable energy in addition to a guaranteed market (Hinman 48).

The main problem with PURPA was implementation. Despite being a federal regulation, it was left up to the state to implement. This allowed for wide inconsistencies - including some states that did nothing ("History of Major Energy Policy Landmarks"). The Federal Energy

Regulatory Commission, charged with regulating interstate transmission of electricity, also caused some problems (Hinman 49). They affirmed that PURPA mandated that utilities buy all of the power generated by these measures. However, FERC determined that avoided costs strictly referred to the financial costs avoided by the utility. This interpretation made it more difficult for green energy projects because it ensured that renewable energy would only be installed when fossil fuel prices were high enough to make building a new coal or natural gas fired plant impossible financially (Hinman 50). This became clear under Reagan when fuel prices dropped significantly. Low fuel prices, combined with Reagan's destruction of the ITC, made it too expensive to produce renewable energy (Hinman 53). In short, the FERC interpretation favored the economy over the environment (Hinman 50).

The Public Utility Regulatory Policies Act of 1978 received its final blow in 2005 with the Energy Policy Act. Twenty-seven years after PURPA was put in place, this act further disfavored renewable producers by making it possible for utilities to not buy energy produced by sustainable methods (Hinman 54).

Energy Security Act (1980)

The Energy Security Act, signed into law by Jimmy Carter, is composed of six main acts and sets forth a variety of initiatives (See chart). This act is important to the solar market because it furthers economic incentives for solar energy and once again demonstrates the federal government found solar energy to be a viable, important pursuit.

Energy Security Act of 1980[16]	
Initiative	**Purpose**
Title I: U.S. Synthetic Fuels Corporation Act	Created the Synthetic Fuels Corporation (1980-1985) with the purpose of partnering with industry for the creation of a market for synthetic liquid fuels produced in the United States.
Title II: Biomass Energy and Alcohol Fuels Act	Established the Office of Alcohol Fuels and the Office of Energy from Municipal Waste. Also guaranteed loans for small-scale biomass energy projects.
Title III: Energy Targets	Stated that the president must submit energy targets (goals, not legally binding) for net imports, end-use consumption and domestic production of energy for 1985, 1990, 1995 and 2000.
Title IV: Renewable Initiatives	Created incentives for the use of renewable energy resources.
Title V: Solar Energy and Conservation	The purpose of this initiative was to encourage energy conservation and use of solar energy in an attempt to decrease dependence on foreign oil. It also set up the Solar Energy and Conservation Bank, which was repealed in 1992.
Title VI: Geothermal Energy Act	The Geothermal Energy Act requires that geothermal energy be considered in all new federal buildings. It also authorizes loans from the Geothermal Resources Development Fund, which can be canceled if the target reservoir is deemed unacceptable for development. The loans are for the purpose of exploring and determining the economic viability of such geothermal reservoirs.
Title VII: Acid Precipitation Program	Sets up a task for to study the causes of acid precipitation.
Title VIII: Strategic Petroleum Reserve	Calls for a reserve of 500,000,000 barrels of crude oil to be in storage before any can be sold. This reserve must increase its supply by 100,000 barrels a day until the capacity is reached.

Table 1

[16] ("History of Major Energy Policy Landmarks")

Energy Policy Act of 1992

The most important aspect of the Energy Policy Act of 1992 is the production tax credit (PTC) it creates. This PTC gives taxpayers a credit of $0.015 per kilowatt hour of electricity, adjusted for inflation, assuming the meet certain qualifications (see Table 2).

Qualifications for Production Tax Credit[17]	
Energy must be….	**Details**
…produced by the taxpayer	• Taxpayer must have ownership interest in the facility
…from a qualified energy resource	• Applied to only wind and closed-loop biomass facilities to begin with • New sources were added over the years – wind, biomass, small irrigation power, solar, geothermal, municipal solid waste, hydropower, marine and hydrokinetic power were all acceptable energy resources[18]
…made at a qualified facility	• No specifications
….produced during the ten year period beginning on the date the facility was originally place in service	• Only applies to newly built buildings that begin producing energy during the period in which the PTC was in place and active • Also applies to retrofits to old facilities assuming the remodeling accounts for at least 80% of the project
…sold by the taxpayer to an unrelated person during the taxable year	• Energy must be sold to count for the credit • Related persons is defined as, “a person [that[] would be treated as a single employer under the regulations prescribed under section 52(b)” (Section 45(e) (4)) • Related persons includes employees of business entities that are held under common control

Table 2

[17] Hinman

[18] Section 202 of the Energy Policy Act of 2005 amends this part of the Energy Policy Act of 1993 in order to revise requirements for incentive payments. It assigns 60% of appropriated funds for any given year to facilities that use solar, wind, geothermal or closed-loop biomass technology (“H.R.6”).

These qualifications were put in place in response to a variety of problems created by previous bills. Motivated by tax shelters created during the wind boom of the early 1980s, Congress worked hard to impose limitations on eligibility for the PTC (Hinman 55). There were other motivations as well. The ten year spread in time, for example, was put in place in order to encourage investors to build projects that would actually continue to generate electricity (Hinman 56). However, the spread also created some uncertainty because receiving the full benefit of the PTC reliance on continued operation of the plant (Hinman 57). This creates a disincentive to build a new project if it is nearing the sunset date due to insecurity surrounding whether or not the PTC would be renewed (Hinman 58).

Besides the disincentive to build close to the sunset date, this bill has additional problems, much like the previous bills discussed. The biggest problem was that the PTC was ill-equipped to sustain market growth at times when fossil fuel was cheap and the economy was in recession. If no one is building new plants or buying much energy in the first place, then investors do not have much to gain from the credit.

The Energy Policy Act of 2005

The Energy Policy Act of 2005 was passed at a time of rising fossil fuel prices (and therefore high avoided costs for utilities) (Hinman 54). The act creates an investment tax credit worth 30% of the value of solar projects ("Tax Credit Extension"). Originally meant only for 2006 and 2007, the ITC was extended at the end of 2006 and then for another eight years in 2008 (Fehrenbacher). Most recently, the ITC was extended again, preventing a slowing down of the solar market.

Arguably, this bill is hugely important for the solar energy market. Since it was implemented in 2006, annual solar installations have grown by a compound rate of 76% ("Tax

Credit Extensions"). While it could be that this is a correlation and not a causation, it is noteworthy that this particular ITC has had an oversized influence on the United States solar industry. It forces solar companies to be more flexible and helped to create financial benefits when solar was expensive. And while it was meant to ramp down as clean energy got cheaper, the most recent extension has prevented some companies – such as SunPower, one of America's largest solar companies – from focusing on international markets (Fehrenbacher).

Executive Order 13423 (2007)

"Strengthening Federal Environmental, Energy and Transportation Management", better known as Executive Order 13423, was signed by President George W. Bush on January 24, 2007. In addition to rescinding previous executive orders including 13101, 13123, 13134, 13148 and 13149 this order demands that federal agencies conduct their environmental, transportation and energy related activities in support of their respective missions in an environmentally, economically and fiscally sound manner while continuously improving on this front. More specifically, Executive Order 13423 sets goals pertaining to energy efficiency, acquisition, toxic chemical reduction, recycling, sustainably buildings, electronics stewardship, fleet sustainability and water conservation (""FedCenter – EO 13423"). There is also a specific renewable energy goal, which includes solar energy ("Instructions for Implementing Executive Order 13423").

Executive Order 13423 was ultimately revoked by Obama's Executive Order 13693 in 2015, however it represents an important shift in the federal government's priorities. Despite Bush's conservative beliefs, he still put an executive order in place that made a clear statement that the government needed to be sustainable.

Energy Improvement and Extension Act (2008)

Signed into law on October 3, 2008, the Energy Improvement and Extension Act (EIEA2008) works mainly to establish tax credits and incentives in order to promote more sustainable energy choices. These incentives include measures to support small wind systems, plug-in electric vehicles, biodiesel, energy produced from tidal forces and a wide variety of other sustainable forms of energy. Most relevant to this study, however, is the act's removal of the cap on tax credits for purchases of residential solar panels. Before the act, solar installations could receive a 30% tax credit with a two-thousand dollar cap. By removing this cap, the Energy Improvement and Extension Act helps to promote the solar energy economy by making residential solar panels increasingly enticing. EIEA2008 also extends a 2005 ITC for businesses that allows for a 30% tax credit for solar systems through December 2016.

The Present: Barack Obama 2009-2016

Obama is often accused of being all talk and no action on climate change issues (Goodell). Is that a fair analysis? Since Obama has taken office, solar generation in the United States has increased solar energy production twenty-fold. On top of that, there has been a 7.22% decrease in greenhouse gases since Obama has taken office (Murphy).

American Recovery and Reinvestment Tax Act of 2009

The American Recovery and Reinvestment Tax Act of 2009 (ARRA) represents Obama's reaction to the recession of the early 2000s. While it was not meant entirely as an energy bill, it does include a range of policies relevant to the solar energy market. Beyond impacting the renewable market directly, it is noteworthy that ARRA came at a time when there was a drop in fossil fuel demand, and therefore prices – making it cheaper to produce electricity traditionally

(Hinman 64). As a result, ARRA was especially important for maintaining the solar energy market.

There are three main sections of ARRA that are relevant to the solar energy market. First, Section 1101 extends the PTC for various forms of renewable energy through 2012 (Hinman 64). Second, Section 1102 allows taxpayers to take a 30% ITC instead of the PTC, assuming that the taxpayer puts in service a qualified investment credit facility during 2009, 2010, 2011, or 2012 (Hinman 65). Third, Section 1603 provides for qualifying taxpayers to apply to the Secretary of the Treasury for a grant equal to the amount of the ITC that the taxpayer could otherwise take under Section 1102 (Hinman 64).

Why is this important? While it seems like all of these provisions would result in the same amount of return for the investor, ARRA actually allows for a renewable energy developer who builds a project between 2009 and 2013 that would qualify for the PTC to choose from a selection of options to fit their needs, or the needs of their investor. The PTC is the best option if the developer or investor has reliable income that they want to offset for a few years, for example. Contrastingly, the ITC is the best option for investors and developers who have an immediate desire or need for tax credits, provided in one lump sum. Finally, if there is no need for tax credits then developers and investors can ask the government to reimburse them for 30% the cost of the project (Hinman 67). Theoretically, having options should help attract a wider variety of investors – however, due to the short-lived nature of ARRA, projects would have had to have been running by the end of 2012, so investors had to break ground very quickly after ARRA came into effect.

Rural Energy for America (2014)

According to the United States Department of Agriculture, the purpose of REAP is to "increase American energy independence by increasing the private sector supply of renewable energy and decreasing the demand for energy through energy efficiency improvements. Over time, these investments can also help lower the cost of energy costs for small businesses and agricultural producers." (USDA). This is achieved through guaranteed loan financing and minimal grant funding for agricultural producers and rural small businesses. The funding can be used for purchasing or installing renewable energy systems including, but not limited to solar, biomass, geothermal, or ocean. It can also be used for making energy efficiency improvements such as installing high efficiency HVAC systems, improving insulation, and switching from diesel to electric irrigation motors. Loans can be for up to 75% of the total eligible project costs, up to an 85% loan guarantee, with a $5,000 minimum and $25 million maximum (see Table 3 for terms). Rates are negotiated with the lender and subject to USDA approval. Contrastingly, grants are for up to 25% of the total eligible project costs. There is a $2,500 minimum and a $500,000 maximum for renewable energy system grants whereas the minimum for energy efficiency project grants is $1,500 with a $250,000 maximum (USDA).

Terms for REAP Loans[19]	
Project Type	**Maximum Term (in years)**
Real estate	30
Machinery and equipment	15 – or useful life
Capital Loans	7
Combined Real Estate and Equipment Loans	30

Table 3

While Rural Energy for America (REAP) was originally created in 2008 by combining the 2002 Farm Bill Energy Efficiency Improvements and Renewable Energy System program with slightly modified version of a program to fund energy audits and assistance using renewable energy technology from the same bill, I include REAP as an Obama White House program because of the drastic changes that occurred in 2014 which turned the bill into a greater force (SAG). The 2008 Farm Bill only provided for five years of funding. However, in 2014, mandatory funding was add in to the annual Farm Bill, including a permanent mandatory baseline of $50 million annually in funding. Thus, as long as congress renews REAP by 2019, the next Farm Bill will not need to provide for new funding (SAG). Funding for the Rural Energy for America program is currently governed by 7 CFR 4280, Subpart B and is authorized by Title IX of the Agricultural Act of 2014 (USDA).

[19] USDA

Rural Energy for America Program Funding[20]	
Fiscal Year	**Mandatory Funding (in millions)**
2014	$50
2015	$50
2016	$50
2017	$50
2018	$50
5yr projection	$250
10yr projection	$500

Table 4

REAP also receives an annual appropriation through the annual agricultural appropriations bill. Levels of discretionary funding are determined annually by congress by this bill (SAG).

[20] "Rural Energy For America Program"

Past Rural Energy for America Program Funding[21]	
Fiscal Year	**Discretionary Funding (in millions)**
2010	$39.3
2011	$5.0
2012	$3.4
2013	$3.1
2014	$3.5

Table 5

Since 2008, REAP has funded almost $300 million in grants and $228 million in loan capital, funding over 9,000 renewable energy projects (SAG). By making solar accessible to average Americans, REAP has truly helped to expand the green energy economy while also promoting solar energy more generally.

Executive Order 13693 (2015)

On March 19, 2015 President Obama signed Executive Order 13693 – Planning for Federal Sustainability in the Next Decade – into effect. The order aims to maintain federal leadership in sustainability and greenhouse gas emission reductions by targeting 3 scopes. Scope 1 includes all direct greenhouse gas emissions from sources that are owned or controlled by the agency while scope two describes direct greenhouse gas emissions resulting from the generation of any steam, heat, or electricity that is purchased by a federal agency. Finally, scope three includes any indirect greenhouse gas emissions that are related to federal agency activity, such as vendor supply chains and employee traveling ("Executive Order").

[21] "Rural Energy for American Program"

Executive Order 13693 is very broad, covering everything from emissions and efficiency to water usage and fleet sustainability. As a result, not all sections are relevant to this study. Table 6 lists sections relevant to renewable energy.

Executive Order 13963[22]		
Section	**Subsection (if applicable)**	**Details**
Section 1 - Policy	n/a	• Executive departments and agencies are some of the national leaders in building a clean energy economy, which is important for sustaining prosperity and the health of our people and environment into the future. • There is an opportunity to reduce agency direct greenhouse gas emissions by at least 40% of the next decade while also fostering innovation, reducing spending, strengthening the federal community. • The first priority is to reduce energy use and cost. • The second priority is to find renewable and/or alternative solutions, which is important for improving energy and water security for the nation.
Section 2 – Agency Greenhouse Gas Emission Reductions	n/a	• All heads of federal agencies must propose percent reduction targets for the fiscal year 2025. • Targets should be based on the 2008 baseline. • The Chair of the Council on Environmental Quality(CEQ) and the Director of the Office of Management and Budget (OMB) shall receive these targets for review.

Section 3 – Sustainable Goals for Agencies	A	• The head of each agency shall do the following where life-cycle cost-effective, beginning in 2016.
		  ○ Promote building energy conservation, efficiency and management
		  ○ Improve data center energy efficiency

	B	• The following percentages of the total amount of building electric energy and thermal energy must be clean energy (renewable electric energy and alternative energy[23])
		  ○ >10% in 2016 and 2017
		  ○ >13% in 2018 and 2019
		  ○ >16% in 2020 and 2021
		  ○ >20% in 2022 and 2023
		  ○ >25% in 2025 onwards

[22] "Executive Order"

[23] For the sake of E.O. 13693 both alternative energy and renewable electric energy can be produced by solar means

	C	• The percentage of the total amount of building electric energy consumed by the agency must meet the following minimums for renewable electric energy. ○ >10% in 2015 and 2017 ○ >15% in 2018 and 2019 ○ >20% in 2020 and 2021 ○ >25% in 2022 and 2023 ○ >30% in 2025 and onwards
	D	• In the renewable energy target established by 3(b) include the following actions, listed in order of priority ○ Installing renewable energy on-site at federal facilities and retaining the corresponding renewable energy certificates (RECs) or obtaining equal value replacement RECs ○ Purchasing energy that includes the installation of renewable energy and the retention of corresponding RECs or obtaining equal value replacement RECs ○ Purchasing electricity and corresponding RECs or obtaining equal value replacement RECs ○ Purchasing RECs
	E	• In the alternative energy target established by 3(b) include the following actions ○ Installing thermal renewable energy on-site of federal facilities and retaining corresponding RECs or obtaining equal value replacement RECs ○ Installing combined heat and power processes on-site of federal facilities ○ Installing fuel cell energy systems on-site at federal facilities ○ Obtaining and using energy from an innovative project that includes the active capture and storage of carbon dioxide emissions from energy generation ○ Resorting to other alternative energy approaches that promote the policy set forth in section 1 and the goals of section 2

Table 6

Executive Order 13693 helps to promote the solar energy market in two main ways – symbolically and literally. While the goals required by the order will increase the federal reliance on solar, thus adding to the demand for solar energy, it is perhaps more important that

the order shows the government's commitment to renewable energy. As stated in section 1, one of the main goals of this executive order is to maintain the federal government's status as role models in sustainability. Assuming this is achieved, the best practices utilized by the government will help to advance the economy as well.

Suggested Policies to Foster a Stronger Solar Energy Economy

> "Pew's past research has demonstrated that policy matters. Whether at the state, national, or international level, strong clean energy goals and policies are driving deployment of advanced energy goods and services." (*Power Surge* 2)

In order to keep the solar economy going strong, it is important to maintain a regime of policies that creates an environment that is welcoming to investors and consumers of solar energy. The United States needs a comprehensive energy plan that has a long enough shelf life to make investors feel secure, protects the solar economy from harmful state actions and provides financial incentives for homeowners and other individuals to install solar on their property.

For starters, it is important to keep the ITC in place if the government wants to keep the solar energy economy growing at a significant rate. Tax credits make it possible for individuals to afford panels, which currently maintain a high initial cost. Most people do not have the capital needed to make the switch to solar, even if they would greatly benefit from the savings throughout the life of the panels. By making it possible to install panels, the ITC provides for a greater number of individuals to benefit from solar, whether they are doing it for the financial savings or for their conscious.

Equally important, net-metering laws must be strengthened and protected. Without them, residential solar panels make a lot less sense financially. Additionally, these laws are crucial when it comes to reducing American dependence on dirty electricity. If the goal is to increase the amount of renewables in electricity portfolios – which it should be – then allowing panel owners to sell back the extra electricity produced on their homes is critical. If homeowners are not allowed to do this, clean energy is lost. This problem will get a bit better once powerful enough batteries are mass produced to store extra electricity produced by one's panels, however, it will still be important then to have net-metering intact in order to increase the percentage of electricity that is produced by sustainable means in the United States.

Executive orders and other policies that set goals for the energy portfolios of United States governmental agencies are not critical, but they do act to send an important message and to add to the demand for green energy. For example, the priority the military is putting on increasing their solar capacity shows the commitment the United States has to clean energy and could act to convince individuals that would normally see solar energy as nonsense of the benefits of solar. Also, how can the government ask its citizens to be sustainable if they are not doing it themselves? By setting reachable, yet lofty goals for all federal agencies, the government is helping to strengthen the solar energy economy greatly. Thus, these types of policies should remain part of the renewable energy package.

In an ideal world there would also be funding and policies in place to promote innovation. We see some of this in policies like Executive Order 13693, which aims in part to channel the energy of federal agencies into finding new ways to produce energy sustainably.

Innovation could lead to cheaper panels, more efficient[24] panels and storage batteries that could make the need for strong renewable energy policies obsolete. If panels were cheaper, more individuals could purchase them outright. If storage batteries existed then net-metering would not be as critical. While the maintenance of these policies would still be ideal, it would be beneficial to further strengthen the solar energy economy in a way that would make it less susceptible to negative changes in solar energy policy.

Conclusion

I am not the only one to argue that a comprehensive energy plan is needed to protect renewables. Scholar Hinman states the following about the wind industry, "permanent energy legislation is needed to secure long-term profitability in the wind energy industry" (Hinman 64). The same is true for the solar industry.

This paper set out to study the impact of renewable energy policies on the solar energy economy. The answer is clear – the current solar energy economy exists only because of these policies. Without them, solar panels would not be mainstream[25] as they would be too expensive for the average person. Only environmentally conscious millionaires would be able to harness the never ending electricity generating power of the sun while those without such

[24] In October 2015, SolarCity claimed to have created the world's most efficient rooftop panel, coming in with a 22% efficiency (the average is 15%). These panels will create up to 40% more electric output while costing the same as traditional panels to produce, about 0.55 cents per watt. Each panel has a 355 watt capacity and performs better at high temperatures, allowing for more energy production. Right now the panels are in test production at their 100MW plant in Fremont, CA and will move to mass production at the 1GW facility in Buffalo, NY, which is scheduled to be at full capacity in early 2017. At full capacity the Buffalo Plant is expected to produce up to 10,000 solar panels a day. SunPower, another brand, comes in second place with 21.5% efficiency (Libonate).

[25] There is definitely still some mainstreaming to do. Many individuals are still not comfortable with the idea of putting panels on their homes for a variety of reasons. Some believe they are ugly, others worry about their safety or the value of their home. Others worry that some solar companies are scams.

economic resources would have to continue to rely on dirty electricity, which causes the very environmental problems that would impact them more than their wealthy counterparts.

Renewable energy policies make the current solar economy possible by lowering the barrier of entry to the renewable market. While some may argue that the government is meddling too much, in this case the meddling is necessary and important. An ever-growing country fueled only by finite, dirty sources can never be as strong as we would want it to be. Clean, sustainable energy is not only better for the environment, but it is cheaper in the long run and helps to protect our nation's security. Honestly, that is something that everyone should be able to get behind.

The United States is now at a crossroads. It is unclear whether the next president will be like Barack Obama or even like George W. Bush – both of whom were willing to support the solar market as needed. As it stands at the time of writing, only two presidential candidates[26] believe that climate change is caused by humans and favor incentives for renewable energy (Hilary Clinton and Bernie Sanders) whereas the two Republican frontrunners, Donald Trump and Ted Cruz, have claimed that climate change does not exist, is not causes by humans or the United States does not have to act ("How Do the Candidates Stack Up on Four Key Issues?"). Therefore, there is a real chance that the next president could call for major cutbacks to the current renewable energy policy package, either by working with congress or through executive orders. If that was to happen, it is unclear whether the solar energy economy would survive.

[26] An interesting side note – SolarCity has looked at each primary candidate's home to see which candidate has the best home for solar. Donald Trump stands to save the most by going solar due to New York's high utility prices and strong solar incentives. Ted Cruz's house would only be a mediocre candidate for residential panels due to a lack of incentives in Texas. Like Trump, Hilary Clinton lives in New York, making her potential savings from solar significant. Bernie Sander's home is also ripe for solar. Vermont wants to source 75% of its electricity from renewables by 2032 and the Burlington, Vermont utility company is very generous when buying solar electricity from homeowners (Fischer).

For sure, the strong growth seen over the past few years would slow down. However, no policy change could completely erase all of the residential panels or solar farms that have been built. These assets would help to ensure that the solar energy economy does not completely collapse. Yet, such a blow would cripple the chances of moving forward and making a sizeable dent in the United States' energy portfolio.

It is my hope that more research could help to mitigate the chance for collapse moving forward. Right now, the solar energy economy is still relatively young. Solar panels are just beginning to appear in many neighborhoods and there are still plenty of Americans that do not believe in panels simply because they do not believe in anthropogenic climate change. These individuals, corporations and governmental bodies will ultimately need to be convinced if the solar energy economy is to truly take off. While renewable energy policy makes it possible for the solar economy to exist, demand must also increase to sustain growth past a certain point. My study has focused on illuminating the history of renewable energy policy in order to illustrate the necessity of such policies to the solar energy economy. Research is still needed to show the mechanisms by which these policies impact growth and how to improve their efficiency. There is also a need for research pertaining to perceptions of solar energy, how policy makers make decisions regarding renewables and on policy-feedback. It is not enough to just have a policy, for example, but the policy's benefits must also be pitched to the public. That begs another question – are solar businesses responsible for promoting the solar incentives or does that fall to the government? While the scope of my work is already too broad to include these topics, it is clear that they would be a worthy research topic moving forward.

One thing I have not been able to address in this study due to scope is the way issues of race and socioeconomic status play into this issue. A lot of research can be done in this area. People of color are disproportionally affected by environmental issues, as are people with lower SES. At the same time, these people are less likely to be benefiting from the majority of the pollution, emissions and waste. This issue can be seen in debates over whether developing countries should have to adhere to the same guidelines as countries like the United States when it comes to developing. The argument is that the United States was allowed to pollute and therefore grow quickly as a result of those actions, thus developing nations should have the same chance. Policies should also take the opportunity to address some of these problems by providing deeper subsidies for people with lower SES and creating "green" job pipelines for minorities. These groups of people have the most to lose and the most to gain from the health of the environment, thus the green energy economy should be used as a force of good.

While the future of the solar energy economy may be unclear, it is obvious that the conversation must continue. Too much is at stake to continue on a path of all dirty electricity, all the time. This is a case of individual effort not being enough – in order to truly impact anthropogenic climate change the help of the federal government is needed. Conscious-minded individuals can only turn off so many lights and walk so many miles to work. In order for real change to happen, the government needs to make conditions favorable for bigger changes. Renewable energy policy is an example of this. If the United States government continues to promote positive change in the energy economy, then America can truly move through the 21st century successfully as a global leader.

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