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I. INTRODUCTION

The use of solar energy, and other sources of renewable energy, is rapidly growing both in the United States and around the world.[1] Renewable energy sources, like wind, hydroelectric, and geothermal, provided approximately 19 percent of the total energy consumed worldwide in 2012, and accounted for approximately 22 percent of the world's electricity production in 2013.[2] However, in the United States, a world leader of technology and energy consumption, renewable sources generated only 13 percent of the electricity generated in 2014, and only 9.7 percent of the total energy consumed in 2012.[3] This fraction is worrisome, since renewable sources of energy carry far less external costs of production and consumption than fossil fuels do.[4] These costs include contribution to global warming; air, water, and land impacts; and ecological harm; all of which are costlier with regards to fossil fuels.[5] When it comes to energy, United States policy disregards long term environmental externalities, focusing only on immediate costs. Like the energy it relies on, this policy is not sustainable.

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[1] RENEWABLE ENERGY POLICY NETWORK FOR THE 21ST CENTURY, RENEWABLES 2014 GLOBAL STATUS REPORT, 15 (2014), *available at* http://www.ren21.net/Portals/0/documents/Resources/GSR/2014/GSR2014_full%20report_low%20res.pdf; U.S. ENERGY INFORMATION ADMINISTRATION, ELECTRIC POWER MONTHLY, tbl.1.1 (2015), *available at* http://www.eia.gov/electricity/monthly/pdf/epm.pdf.

[2] RENEWABLE ENERGY POLICY NETWORK FOR THE 21ST CENTURY, *supra* note 1, at 21, 25. These and all other figures in this article do not include nuclear energy as a form of renewable energy. *Id.*

[3] U.S. ENERGY INFORMATION ADMINISTRATION, *supra* note 1; U.S. ENERGY INFORMATION ADMINISTRATION, MONTHLY ENERGY REVIEW, tbl.1.1 (2015), *available at* http://www.eia.gov/totalenergy/data/monthly/pdf/sec1_3.pdf.

[4] GEORGE KEITH ET AL., THE HIDDEN COSTS OF ELECTRICITY: COMPARING THE HIDDEN COSTS OF POWER GENERATION FUELS 4-10 (2012), *available at* http://www.civilsocietyinstitute.org/media/pdfs/091912%20Hidden%20Costs%20of%20Electricity%20report%20FINAL2.pdf.

[5] *Id.*

It is a scientific fact that greenhouse gases, produced in large part by consuming fossil fuels, are one of the main drivers of ongoing, anthropogenic climate change (i.e. global warming), and that this presents one of the gravest challenges and threats to humans and our world.[6] If unchecked, global warming will have catastrophic and irreversible effects, some of which are already observable today.[7] Likely results of climate change include decreased crop production, scarcity of fresh water, rising sea levels, extreme flood and fire damage, and harms to ecosystems and human health.[8] The United States only contains about 4.5 percent of the world's population,[9] but as of 2012 consumes approximately 18 percent of the world's energy[10] and creates 16 percent of the world's CO_2 emissions from energy consumption[1112]. As a result, the United States has a moral duty to reduce the disproportionate harm it is causing to the world through its energy consumption, specifically by reducing, and eventually ending, its use of fossil fuels.

Of the various forms of renewable energy, solar and wind energy production have had the largest growth rates in the past decade, both in the United States and worldwide, and continued growth is expected.[13] This

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[6] Shannon Baker-Bransletter, *Distributed Renewable Generation: The Trifecta of Energy Solutions to Curb Emissions, Reduce Pollutants, and Empower Ratepayers*, 22 VILL. ENVTL. L. J. 1, 4 (2011); *see also* JONATHAN M. HARRIS ET AL, THE ECONOMICS OF GLOBAL CLIMATE CHANGE, 3 (2015), *available at* http://www.ase.tufts.edu/gdae/education_materials/modules/the_economics_of_global_climate_change.pdf.

[7] *Id.*

[8] *Id.*; *see also* JONATHAN M. HARRIS ET AL, THE ECONOMICS OF GLOBAL CLIMATE CHANGE, 18 (2015), *available at* http://www.ase.tufts.edu/gdae/education_materials/modules/the_economics_of_global_climate_change.pdf.

[9] *International Energy Statistics*, U.S. ENERGY INFORMATION ADMINISTRATION, http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=93&pid=44&aid=33 (last visited Feb. 14, 2015). This figure is for the year 2011. *Id.*

[10] *International Energy Statistics*, U.S. ENERGY INFORMATION ADMINISTRATION, http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=44&pid=44&aid=2 (last visited Feb. 14, 2015). This figure is for the year 2012. *Id.*

[11] *Id.*

[12] This does not include energy consumption or CO_2 emissions related to U.S. imports. *International Energy Statistics - Notes*, U.S. ENERGY INFORMATION ADMINISTRATION, http://www.eia.gov/cfapps/ipdbproject/docs/IPMNotes.html#ind (last visited Feb. 14, 2015).

[13] RENEWABLE ENERGY POLICY NETWORK FOR THE 21ST CENTURY, *supra* note 1, at 13, 15, 21; *Electricity Data Browser*, U.S. ENERGY INFORMATION ADMINISTRATION, http://www.eia.gov/electricity/data/browser/ (last visited Feb. 14, 2015).

growth is due to sharply falling costs, constant improvements in technology, and government incentives.[14] But is it enough? The proportion of energy production from solar, wind, and other renewable sources is still relatively small.[15] Furthermore, legislative efforts to stymie renewable growth and protect the interests of fossil fuel producers and utility companies,[16] as well as a lack of political will to enact large enough policy changes,[17] are standing in the way of the drastic reduction in fossil fuel use that is necessary to protect the future of this world and its inhabitants.

Although solar is not the only option for clean energy, this article focuses primarily on solar energy in the United States, including: (1) the benefits of solar; (2) the laws and policies promoting solar energy production, and why they are insufficient; and (3) the legal and political efforts to hinder the growth of solar energy.

II. THE CASE FOR SOLAR ENERGY

Solar electricity production has seen stunning growth rates in the past five years: 2011 saw a 67 percent increase in generation over 2010, 2012 saw a 42 percent increase, 2013 saw a 47 percent increase, and 2014 saw a 104 percent increase.[18] Even so, solar accounted for a paltry 0.46 percent of electricity production in 2014 (by comparison, wind power made up 4.5 percent and renewables totaled 13 percent of electricity production).[19] This does not mean that solar should be disregarded, though. Rather, it means that the solar industry—the manufacturing and installation of solar capacity—is just beginning to take off, and that solar energy will become a substantial part

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[14] RENEWABLE ENERGY POLICY NETWORK FOR THE 21ST CENTURY, *supra* note 1 at 13-14, 22.
[15] *See* RENEWABLE ENERGY POLICY NETWORK FOR THE 21ST CENTURY, *supra* note 1 and accompanying text; *see also* U.S. ENERGY INFORMATION ADMINISTRATION, *supra* note 3 and accompanying text.
[16] *See, e.g.*, Evan Halper, *Koch brothers, big utilities attack solar, green energy policies*, L.A. TIMES, Apr. 19, 2014, http://www.latimes.com/nation/la-na-solar-kochs-20140420-story.html#axzz2zRBMvGrB&page=1.
[17] *See* THE PEW RESEARCH CENTER, PUBLIC PRIORITIES: DEFICIT RISING, TERRORISM SLIPPING, 1 (2012) *available at* http://www.people-press.org/files/legacy-pdf/1-23-12%20Priorities%20Release.pdf.
[18] U.S. ENERGY INFORMATION ADMINISTRATION, *supra* note 1, at tbls.ESB.1 & 1.1.A.
[19] U.S. ENERGY INFORMATION ADMINISTRATION, *supra* note 1, at tbl.ESB.1.

of the United States' renewable energy portfolio.[20] Projections for the federal government's SunShot Initiative, a program aimed at stimulating growth of solar power in the United States, indicate that solar power could meet 14 percent of the nation's electricity demand by 2030, and 27 percent by 2050.[21]

However, no single renewable energy source alone need be the solution. Clean renewables like solar, wind, and geothermal should all play an integral part in ending the United States' dependence on fossil fuels, and drawing from multiple sources spurs competition and innovation that will reduce costs and improve technology.

Solar energy has a number of desirable qualities. Perhaps foremost among them is its extremely low external cost relative to fossil fuels and some of the other renewable energy sources. Solar energy has an extremely minimal impact on global warming.[22] Assessments of lifecycle CO_2 emissions per kilowatt-hour of electricity produced show that solar and wind power emit a small fraction of the CO_2 that coal and natural gas emit; they also emit less greenhouse gases than biomass/biofuels (e.g. ethanol).[23] This consideration alone should outweigh any difference in monetary costs, and in fact, a 2010 study found that two-thirds of Americans would be willing to pay more for their utility bill if their utility company increased its use of renewable energy.[24]

Solar and wind are also far less costly than fossil fuels and biomass in terms of air pollution, water use and pollution, and land impacts (including, mining, deforestation, and ecological harm).[25] A 2011 Harvard study found that estimates of the total annual external costs of coal in the U.S., including

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[20] *See* U.S. DEP'T OF ENERGY, SUNSHOT VISION STUDY, xix (2012), *available at* http://energy.gov/sites/prod/files/2014/01/f7/47927.pdf.

[21] *Id.* It is quite possible that these projections are an underestimate, since they do not account for the possibility of further cost reductions beyond the SunShot Initiative's goal of a 75 percent reduction. *Id.* at 5.

[22] KEITH ET AL., *supra* note 4, at 6.

[23] *See Id.* Lifecycle emissions include direct emissions from fuel consumption, as well as CO_2 emissions from related processing, manufacturing, disposal, mining, transportation, etc. *LCA Harmonization*, OPENEI, http://en.openei.org/apps/LCA/ (last visited Feb. 14, 2015).

[24] *Americans Willing to Pay More for Solar*, RENEWABLEENERGYWORLD.COM (June 25, 2010), http://www.renewableenergyworld.com/rea/news/article/2010/06/americans-willing-to-pay-more-for-solar.

[25] KEITH ET AL., *supra* note 4, at 7-9.

costs to public health, the environment, and climate, range from $175 billion to $523 billion.[26] And while hydroelectric power is a substantial source of renewable energy[27] and has the lowest lifecycle emissions of any source,[28] it will be vulnerable to, and limited by, climate change-related water scarcity,[29] and it often has serious local ecological effects.[30]

Solar energy's potential makes it an appealing resource as well: the earth receives an enormous amount of energy from the sun,[31] so much that the amount of solar energy falling on the United States in one hour of noontime summer sun is about equal to the country's annual electricity demand.[32] To meet the United States' electricity demand, photovoltaic panels would have to be placed on just 0.6 percent of the United States' total land area.[33] The fact that solar panels can be placed on buildings and homes, and that their efficiency is still improving, further reduces solar power's land impacts.[34] Even in places with a lower solar resource (i.e. where sunlight is less direct or intermittent), solar power is still feasible: solar potential virtually everywhere in the United States, except Alaska, is significantly higher than anywhere in Germany.[35] Despite this, solar power already provides 7 percent of Germany's annual electricity consumption as of 2014, due to robust government incentivization.[36]

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[26] Paul R. Epstein et al., *Full Cost Accounting for the Life Cycle of Coal*, 1219 ANNALS N.Y. ACAD. SCI. 73, 91 (2011).
[27] U.S. ENERGY INFORMATION ADMINISTRATION, *supra* note 1.
[28] OPENEI, *supra* note 23.
[29] RENEWABLE ENERGY POLICY NETWORK FOR THE 21ST CENTURY, *supra* note 1 at 45.
[30] *Use and Capacity of Global Hydropower Increases*, WORLDWATCH INSTITUTE, http://www.worldwatch.org/node/9527 (last visited Feb. 15, 2015).
[31] STANFORD UNIVERSITY GLOBAL CLIMATE AND ENERGY PROJECT, GLOBAL EXERGY RESEARCH CHART (2007), *available at* http://gcep.stanford.edu/research/exergy/resourcechart.html.
[32] U.S. DEPARTMENT OF ENERGY, *supra* note 20, at 34.
[33] *Id.* at xxi.
[34] *Id.* at 34-5.
[35] *Id.* at 35.
[36] HARRY WIRTH, FRAUNHOFER INSTITUTE FOR SOLAR ENERGY SYSTEMS, RECENT FACTS ABOUT PHOTOVOLTAICS IN GERMNANY 5, 6 (2014).

Solar energy's applications include electricity production, transportation, water and space heating,[37] and water treatment and sanitation.[38] Solar power is also flexible in scale: in addition to large, utility-scale power generation, it can provide small-scale generation in off-the-grid locations and through so-called distributed solar power, which is the placement of solar panels on residences, businesses, and other structures.[39]

In addition to its cleanliness, increasing the United States' solar energy capacity would provide a number of economic benefits that are common to the growth of other renewable industries and to large-scale infrastructural developments. Large growth of solar energy production requires significant investments in installation, manufacturing, and research and development: this spurs economic activity and growth.[40] In 2010, there were an estimated 51,000 solar industry jobs in the United States,[41] which grew to more than 142,000 by early 2014, at a rate 10 times the national average job growth rate.[42] Under conservative projections of solar industry growth, the solar sector could provide about 340,000 American jobs in 2030, and about 440,000 in 2050.[43]

Furthermore, the fuel for solar energy need not be imported, whereas large amounts of fossil fuels need to be imported to meet current demand.[44] Thus, solar energy provides energy independence and security, the importance of which is often touted and for good reason.[45] Yet another

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[37] RENEWABLE ENERGY POLICY NETWORK FOR THE 21ST CENTURY, *supra* note 1 at 19.
[38] *See* SWISS FEDERAL INSTITUTE OF ENVIRONMENTAL SCIENCE AND TECHNOLOGY, SOLAR WATER DISINFECTION: A GUIDE FOR THE APPLICATION OF SODIS (2002), http://www.sodis.ch/methode/anwendung/ausbildungsmaterial/dokumente_material/manual_e.pdf.
[39] U.S. DEP'T OF ENERGY, *supra* note 20, at 3.
[40] *Id.* at xxii-xxiii.
[41] *Id.* at 17.
[42] U.S. DEP'T OF ENERGY, SUNSHOT INITIATIVE, TACKLING CHALLENGES IN SOLAR: 2014 PORTFOLIO, 6 (2014), http://energy.gov/sites/prod/files/2014/08/f18/2014_SunShot_Initiative_Portfolio8.13.14.pdf.
[43] U.S. DEP'T OF ENERGY, *supra* note 20, at 17. Among other factors, these job numbers are based on solar power providing 14% of electricity demand by 2030 and 27% by 2050. *Id.*
[44] *See How Dependent are We on Foreign Oil?*, U.S. ENERGY INFORMATION ADMINISTRATION (May 10, 2013), http://www.eia.gov/energy_in_brief/article/foreign_oil_dependence.cfm.
[45] *See* THE PEW RESEARCH CENTER, *supra* note 17.

benefit is that, due to ever-decreasing costs and the growth of solar capacity, projections for the scenario envisioned by the SunShot Initiative predict that solar power will provide $30 billion of annual savings in electricity costs by 2030, and $50 billion of annual savings by 2050.[46] This would equate to the average household saving roughly $6 per month and $9 per month, respectively, in electricity costs.[47]

Currently, on average, the monetary costs of solar power are still more expensive per kilowatt-hour than generation by fossil fuels and other renewable resources.[48] However, this will not be the case for long, due to the rapid, continuing decline in the cost of solar power.[49] In 2012, solar photovoltaic panels cost about 1 percent of what they did 35 years before.[50] The primary goals of the federal government's SunShot Initiative are to see the average cost of utility-scale solar power reduced by 75 percent between 2010 and 2020, and to see the average cost of distributed solar power reduced to at, or below, retail electricity prices, at which point solar power would be fully cost competitive with other energy sources, even without subsidies.[51] By the end of 2013, the average cost of utility-scale solar power had already fallen to about half of what it was in 2010, meaning that just three years into the SunShot Initiative's ten-year timeline, costs were about two-thirds of the way to reaching the program's targets—market parity.[52]

Due to local market conditions, solar power is already economically competitive in some states, including California and Minnesota,[53] and in a

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[46] U.S. DEP'T OF ENERGY, *supra* note 20, at 14. Again, this is based on the projection that solar power will provide 14% of electricity demand by 2030 and 27% by 2050. *Id.*
[47] *Id.* at 14.
[48] U.S. ENERGY INFORMATION ADMINISTRATION, LEVELIZED COST AND LEVELIZED AVOIDED COST OF NEW GENERATION RESOURCES IN THE ANNUAL ENERGY OUTLOOK 2014, 6 (2014), http://www.eia.gov/forecasts/aeo/pdf/electricity_generation.pdf.
[49] *See U.S. Utility-Scale Solar 60 Percent Towards Cost-Competition Goal*, ENERGY.GOV (Feb. 12, 2014), http://www.energy.gov/articles/us-utility-scale-solar-60-percent-towards-cost-competition-goal.
[50] U.S. DEP'T OF ENERGY, *supra* note 42, at 6.
[51] *Id.* at 6-7.
[52] ENERGY.GOV, *supra* note 49.
[53] U.S. DEP'T OF ENERGY, *supra* note 42, at 6.

large number of cities.[54] Another clear example of falling costs is that, even though global investment in photovoltaic capacity decreased by 22 percent from 2012 to 2013, 32 percent more photovoltaic generating capacity was actually added in 2013 than in 2012.[55]

Even if government support for solar technology were to end after the SunShot Initiative's targets were met, there is no reason to think that the costs of solar power would not continue to decrease, further driving growth of solar power generation.[56] As technology improves and manufacturing and installation volumes increase, costs will continue to fall: it is entirely feasible that solar power will be half the price of coal within one to two decades.[57] Finally, if a CO_2 tax were instituted on electricity production to account for fossil fuels' external costs, it would make solar power and other renewable power sources even cheaper relative to fossil fuels.[58]

A major shift in the United States' energy policy towards solar and other renewable sources of energy is a necessary part of the solution to global warming. It would also improve public and environmental health, and would be economically beneficial. Although changes in public opinion and the economics of energy can help drive the necessary shift, whether there will be a major shift towards solar energy will be heavily impacted by energy-related laws and policies.

Pro-Solar Laws and Policies

The federal government, and many state and local governments, have enacted a variety of laws that allow and promote the growth of solar energy production, either by promoting solar energy specifically or by promoting renewable energies generally. These include tax incentives, regulatory schemes, and financing opportunities. But are certain types of these programs

[54] Herman K. Trabish, *Rooftop Solar is Now Cheaper Than the Grid in 42 American Cities*, UTILITYDIVE (Jan. 14, 2015), http://www.utilitydive.com/news/rooftop-solar-is-now-cheaper-than-the-grid-in-42-american-cities/352799/.
[55] RENEWABLE ENERGY POLICY NETWORK FOR THE 21ST CENTURY, *supra* note 1, at 49.
[56] U.S. ENERGY INFORMATION ADMINISTRATION, *supra* note 48, at 4-5.
[57] Ramez Naam, *Smaller, Cheaper, Faster: Does Moore's Law Apply to Solar Cells?*, SCIENTIFIC AMERICAN (Mar. 16, 2011), http://blogs.scientificamerican.com/guest-blog/2011/03/16/smaller-cheaper-faster-does-moores-law-apply-to-solar-cells/.
[58] U.S. ENERGY INFORMATION ADMINISTRATION, *supra* note 48, at 2-3.

more effective than others, or are they all integral in changing the face of energy production? And more importantly, are the policies currently in place potent enough to bring about drastic reductions in greenhouse gas emissions?

A. *Federal*

Federal support for solar development is primarily financial, from funding research and development of solar technology to subsidizing the implementation of that technology via tax incentives and loan guarantees.[59]

Arguably, the two most important sources of federal support for the growth of solar are the Business Energy Investment Tax Credit[60] ("ITC") and the Residential Renewable Energy Credit[61] ("RREC"). Essentially, these tax credits are the same, except that the ITC is a corporate tax credit and the RREC is a personal tax credit.[62] Both allow for a substantial tax credit, with no cap, of 30 percent of expenditures on solar energy property (e.g. solar panels and solar water heaters), meaning that they effectively reduce the cost of installing solar energy capacity by up to 30 percent.[63] As these are stable, multi-year incentives, they strongly encourage private sector investments in solar manufacturing and installation.[64] Because the cost of solar technology is still relatively high, the ITC and RREC have been vital in the recent growth of solar by overcoming cost barriers to solar investment.[65] By stimulating

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[59] KEITH ET AL., *supra* note 4, at 57-8.
[60] 26 U.S.C. § 49 (2012).
[61] 26 U.S.C. § 25D (2012).
[62] *Compare Business Energy Investment Tax Credit (ITC)*, DSIRE (Mar. 13, 2013), http://programs.dsireusa.org/system/program/detail/658 *with Residential Renewable Energy Tax Credit*, DSIRE (Mar. 13, 2013), http://programs.dsireusa.org/system/program/detail/1235.
[63] *Business Energy Investment Tax Credit (ITC)*, DSIRE (Mar. 13, 2013), http://programs.dsireusa.org/system/program/detail/658; *Residential Renewable Energy Tax Credit*, DSIRE (Mar. 13, 2013), http://programs.dsireusa.org/system/program/detail/1235.
[64] Zachary Scott Simmons, *Subsidizing Solar: The Case for an Environmental Goods and Services Carve-Out from the Global Subsidies Regime*, 32 UCLA J. ENVTL. L. & POL'Y 422, 434 (2014).
[65] *See id.* at 430.

increased manufacturing and installation, these tax credits have also been indirectly contributing to the falling pre-subsidy cost of solar energy.[66]

The ITC and RREC were both enacted as part of the Energy Policy Act of 2005, and after the ITC was extended by the Emergency Economic Stabilization Act of 2008, they are set to expire at the end of 2016.[67] There will still be a 10 percent business tax credit for solar investments after 2016.[68] But notwithstanding the political obstacles to doing so, the ITC and RREC should both be extended in their present form beyond 2016, and perhaps indefinitely, because they are so vital for promoting renewable energy production.

Some argue that, because solar power will be cost-competitive or close to it by the end of 2016, the 30 percent tax credits should be allowed to expire, and the 10 percent tax credit should also expire soon after.[69] However, there is a reason to continue these tax credits that is much greater than simply having a level economic playing field: promoting clean energy for the sake of clean energy. Climate change and the environment must factor into the equation much more so than short-term economics. Unfortunately, the market cares little for these externalities, meaning that if the cost of solar and other renewables is merely equal to that of fossil fuels, there will still be little monetary incentive to invest. If these tax credits are extended, it will ensure not only that solar energy is cost-competitive, but that it will soon undercuts the cost of fossil fuels.[70] This benefits everyone.

Other federal support for solar energy came in the form of the American Recovery and Reinvestment Act of 2009 ("ARRA").[71] This stimulus package provided $90 billion in support of clean energy activities, $25 billion of which went to renewable power generation.[72] One review of

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[66] *See* Naam*, supra* note 57.
[67] Simmons, *supra* note 64, at 433.
[68] *Business Energy Investment Tax Credit (ITC)*, DSIRE (Mar. 13, 2013), http://programs.dsireusa.org/system/program/detail/658.
[69] Camilo Patrignani, *Let the Sun Set on the Solar Industry Subsidy*, THE HILL: CONGRESS BLOG (Jan. 12, 2015, 11:00 AM), http://thehill.com/blogs/congress-blog/energy-environment/229050-let-the-sun-set-on-the-solar-industry-subsidy. This argument was authored by the CEO of a solar development company. *Id.*
[70] *See* ENERGY.GOV, *supra* note 49 and text accompanying notes 51-2.
[71] Simmons, *supra* note 64, at 433.
[72] Joseph E. Aldy, *A Preliminary Review of the American Recovery and Reinvestment Act's*

the ARRA's impacts found that $46 billion of clean energy spending through the ARRA, leveraged over $100 billion in co-investments by the private sector and non-federal governments.[73]

The ARRA included a now-expired 30 percent manufacturing tax credit for renewables with a total tax expenditure cap of $2.3 billion, which supported over 50 solar manufacturing facilities.[74] It also created the Section 1603 Treasury Program, which for about two years allowed solar and other renewable energy developers to receive grants equal to 30 percent of a project's cost, in lieu of the 30 percent tax credit.[75] This grant program was particularly effective in drawing large private sector investments.[76] According to one assessment, the Section 1603 grants delivered more benefits per dollar of government expenditure than tax credits,[77] therefore, restarting the Section 1603 Program would be ideal.

There is also the federal Modified Accelerated Cost-Recovery Program,[78] which allows a business to recoup investments in solar energy through a tax deduction based on depreciation.[79]Additionally, businesses can take advantage of the Department of Energy's Loan Guarantee Program, which has provided $24 billion in loan guarantees since 2009.[80] These programs have been crucial in removing much of the economic uncertainty involved with large-scale investment in a fledgling industry.[81] However, while they are important, loan guarantees are significantly less effective at attracting investment than grants and tax credits.[82]

Clean Energy Package 10 (HKS Faculty Research Working Paper Series RWP11-048, John F. Kennedy School of Gov., Harvard U., 2012), https://dash.harvard.edu/handle/1/5688917.
[73] *Id.* at 12-3.
[74] Simmons, *supra* note 64.
[75] *Id.* at 434-35.
[76] *Id.* at 440-41.
[77] Aldy, *supra* note 72, at 22.
[78] 26 U.S.C. § 168 (2012), *amended by* Pub. L. No. 114-113, 129 Stat. 2242 (amended 2015).
[79] Brian Lips, *Modified Accelerated Cost Recovery System (MACRS)*, DSIRE (Jan. 11, 2016), http://programs.dsireusa.org/system/program/detail/676.
[80] Simmons, *supra* note 64, at 435-36.
[81] *Id.* at 440.
[82] Aldy, *supra* note 72, at 23.

Yet another important form of federal support is a program adopted by the Obama administration in 2012 which incentivizes and expedites the process for developing solar projects on 285,000 acres of federal land in the Western United States.[83] It also opens up an additional 19 million acres of land in the Mojave Desert for the placement of solar plants.[84] There are environmental concerns as to the latter aspect of this plan, given the number of endangered species in the Mojave Desert.[85] Clearly, reckless and unrestricted development of the Mojave would be somewhat contrary to the purpose of clean energy, but it should be possible to cautiously develop the Mojave Desert while still taking conservation interests into account.

While some argue that subsidies for solar energy and other renewables should not be renewed because they will soon be unnecessary,[86] others argue that these subsidies should end because they have thus far failed to substantially change the makeup of energy production, in merely a decade, and will never succeed in doing so.[87] These critics, who are typically politically conservative, opine that renewable energy is a pipe dream; therefore subsidies for solar energy are not economical and simply waste billions of federal dollars.[88] Of course, these critics fail to realize that not only is large-scale renewable power entirely possible,[89] but that the present and future external economic costs of fossil fuels are astronomically higher than current government expenditures on solar and other renewables.[90] This cannot be emphasized enough.

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[83] Julie Cart, *Federal Plan Designed to Create Large Solar Energy Plants*, L.A. TIMES (Oct. 13, 2012), http://www.latimes.com/news/local/la-me-1013-solar-zones-20121013.
[84] *Id.*
[85] *Id.*
[86] *See* Patrignani, *supra* note 69.
[87] *See* Peter Roff, *Obama's Green Unicorn*, U.S. NEWS & WORLD REPORT (Aug. 25, 2014, 1:15 PM), http://www.usnews.com/opinion/blogs/peter-roff/2014/08/25/obamas-green-energy-push-and-subsidies-make-no-economic-sense.
[88] *See id.*; *see also Report: Solar Energy Subsidies Cost $39 Billion Per Year*, THE WASHINTON FREE BEACON (Feb. 12, 2015), http://freebeacon.com/issues/report-solar-energy-subsidies-cost-39-billion-per-year/.
[89] *See, e.g.*, *Wind Energy*, DENMARK.DK (last visited Mar. 7, 2015), http://denmark.dk/en/green-living/wind-energy/. Denmark already gets more than 40% of its energy from wind power and has goals to reach 50% by 2020. *Id.* Denmark plans to be completely fossil fuel-free by 2050. *Id.*
[90] *See* Epstein, *supra* note 26; *see also* Keith, *supra* note 4, at 7.

Even without considering the external cost-related reasons for subsidizing solar energy, the current level of subsidies for solar and other renewables is small compared to past subsidies for other energy sources.[91] For one thing, solar and other non-hydro renewables are still nascent industries.[92] In inflation-adjusted dollars, federal spending on nuclear power averaged $3.3 billion per year over the first 15 years of subsidies for nuclear energy production.[93] Federal spending on oil and gas averaged $1.8 billion per year for the first 15 years.[94] By woeful contrast, spending on renewables averaged less than $0.4 billion per year for the first 15 years.[95] Furthermore, cumulative subsidies up to 2009 totaled almost $450 billion for oil and gas, while those for renewables totaled only $5.7 billion between 1994 and 2009.[96]

Of course, government expenditures on solar have increased substantially in the past several years as investment has gone up, but they are still dwarfed in comparison to historical trends.[97] One must also keep in mind that the reason fossil fuels and nuclear energy are as cheap as they are now, making it difficult for renewables to compete, is that they have been so heavily subsidized in the past and are still subsidized today.[98] Finally, one study that looked at defense spending on "energy security," which is not typically considered a subsidy, found that the cost of keeping aircraft carriers in the Persian Gulf to secure oil shipments alone amounted to $7.3 *trillion* of *peacetime* spending between 1976 and 2007.[99] When looking at the big picture, at other energy subsidies and the external costs of fossil fuels, the fact is that subsidies for renewables are not nearly large enough.

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[91] Nancy Pfund & Ben Healey, *What Would Jefferson Do? The Historical Role of Federal Subsidies in Shaping America's Energy Future*, DBL INVESTORS 6 (Sept. 2011), http://www.dblpartners.vc/resoruce/what-would-jefferson-do/.
[92] *Id.*
[93] *Id.*
[94] Id.
[95] Id.
[96] Id. at 29.
[97] TERRY M. DINAN, CONG. BUDGET OFFICE, TESTIMONY: FEDERAL FINANCIAL SUPPORT FOR FUELS AND ENERGY TECHNOLOGIES 3-5 (2013), http://www.cbo.gov/sites/default/files/cbofiles/attachments/03-12-EnergyTechnologies.pdf.
[98] Pfund & Healey, supra note 91, at 34.
[99] Id. at 28.

While tax credits and other financial incentives are essential to the growth of solar energy, federal funding for research and development is equally important. For example, solar technology would be nowhere near what it is today if NASA had not spent, from 1950 to 2006, almost $1 billion researching solar power.[100] In the decade prior to 2011, the Department of Energy ("DOE") invested over $1 billion in solar energy research, which leveraged another $1 billion in co-investment by the private sector.[101] Since 2007, the DOE's Incubator program, which competitively selects start-up solar technology businesses, has provided over $100 million to such businesses, and leveraged $18 in subsequent private sector investment for every dollar of government spending.[102]

In 2011, the DOE launched its SunShot Initiative, a research-funding program the goal of which is to see the cost of solar energy systems reduced by 75 percent from 2010 prices by 2020.[103] At that price, solar energy will be fully cost-competitive with other electricity sources, even without subsidies.[104] Getting to that point will be enormously beneficial: the SunShot Vision Study projects that if this goal is reached by 2020, solar energy could meet 14 percent of the United States' electricity demand by 2030, and 27 percent by 2050.[105] Funding through the SunShot Initiative is split between national laboratories, universities, and the solar industry.[106] It focuses on research in several areas: (1) improving efficiencies and reducing costs of photovoltaic and concentrating solar power technologies; (2) increasing grid penetration through systems integration; (3) helping new technologies get to market and become widely available, faster and more easily; and (4) reducing the soft costs of solar deployment, such as permitting, installation, and financing.[107] In the first three years of the SunShot Initiative, more than $900 million of funding was provided[108] to over 350 research and development

[100] Id. at 18.
[101] *DOE Pursues SunShot Goal to Achieve Cost Competitive Solar Energy by 2020*, U.S. DEP'T OF ENERGY (Feb. 4, 2011), http://www1.eere.energy.gov/solar/sunshot/news_detail.html?news_id=16701.
[102] *SunShot Incubator Program*, ENERGY.GOV (last visited Mar. 7, 2015), http://energy.gov/eere/sunshot/sunshot-incubator-program.
[103] U.S. DEP'T OF ENERGY, *supra* note 42, at 6-7.
[104] *Id.* at 6.
[105] U.S. Dep't of Energy, *supra* note 20.
[106] U.S. Dep't of Energy, *supra* note 3.
[107] U.S. Dep't of Energy, *supra* note 42, at 7-8.
[108] *Id.* at 10.

projects.[109] The payoff for this investment is clear: just three years into the SunShot timeline, average solar energy system costs had already fallen a striking two-thirds of the way to the program's goal.[110] Not only that, but rooftop solar systems in 2012 cost just one percent of what they did 35 years earlier.[111] This shows the tremendous benefit that relatively small amounts of government spending on research can have, and suggests that spending on research and development is one of the most effective forms of government subsidy.

B. *State*

State policies and incentives for solar energy are, naturally, much more diverse than federal incentives.[112] One of the main types of state policies are Renewable Portfolio Standards, which require utility companies to produce or sell a certain amount of electricity from renewable sources by a specified date.[113] Each Renewable Portfolio Standard ("RPS") is unique, not just in the amounts required or their timeframes, but in which renewable resources qualify, how compliance is achieved, and other requirements like specific amounts from solar energy.[114] RPS policies are designed to encourage cost competition between renewable resources and traditional energy sources, as well as amongst renewable resources themselves.[115] This results in economic development, cost competitiveness for solar and other renewables, and savings for consumers.[116]

As of 2014, twenty-nine states, Washington, D.C., and two territories have RPSs, while nine states and two territories have non-mandatory

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[109] U.S. Dep't of Energy, *The SunShot Initiative: Making Solar Energy Affordable for All Americans*, Energy.gov (Apr. 2015), http://energy.gov/sites/prod/files/2015/08/f25/SunShotfactsheet2015.pdf.
[110] U.S. Dep't of Energy, *supra* note 42, at 10.
[111] *Id.* at 6.
[112] *See Summary Maps*, DSIRE (last visited Mar. 8, 2015), http://programs.dsireusa.org/system/program/maps.
[113] *Renewable Energy Standards*, SEIA (last visited Mar. 8, 2015), http://www.seia.org/policy/renewable-energy-deployment/renewable-energy-standards.
[114] *Id.*
[115] *Id.*
[116] *Id.*

renewable portfolio goals.[117] Some of the most robust RPS policies include California's, which requires 33 percent renewable power by 2020; New York's, which requires 29 percent renewable power by 2015; Colorado's, requiring investor owned utilities to source 30 percent of their power from renewable sources by 2020; and Hawaii's, requiring 40 percent renewable power by 2030.[118] The least ambitious policies include Ohio's, which requires only 12.5 percent renewable power by 2026, and South Carolina's underwhelming goal of 2 percent renewable power by 2021.[119] The RPSs of twenty states and Washington, D.C. have specific requirements or provisions for either solar power or distributed generation (i.e. residential scale).[120] However, solar power growth will still benefit from RPSs which do not have these specific provisions, since most types of solar technologies qualify under all RPS policies.[121]

It should be noted that while RPS policies are certainly effective at stimulating renewable energy growth, states without these standards have also seen significant growth in solar and other renewable power generation due to federal incentives, state programs, and market conditions.[122] One drawback to RPSs — aside from most, if not all, states' policies not being ambitious enough — may be that unless states continue to enact newer, more ambitious standards, renewable power generation may plateau when it reaches the forecasted standards.[123] Furthermore, they do not account for growth in total energy consumption, and thus allow for growth in fossil fuel consumption.[124] Therefore, because of loopholes and the added costs of

[117] DSIRE, RENEWABLE PORTFOLIO STANDARD POLICIES (2014), http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/01/RPS_map.pdf.
[118] *Id.*
[119] *Id.*
[120] DSIRE, RENEWABLE PORTFOLIO STANDARD POLICIES WITH SOLAR OR DISTRIBUTED GENERATION PROVISIONS (2014), http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/01/Solar_DG_RPS_map.pdf.
[121] *See* SEIA, *supra* note 113. Solar heating and cooling do not qualify under all of RPS policies. *Id.*
[122] *Most states have Renewable Portfolio Standards*, EIA (Feb. 3, 2012), http://www.eia.gov/todayinenergy/detail.cfm?id=4850.
[123] James E. Parker-Flynn, *A Race to the Middle in Energy Policy*, 15 SUSTAINABLE DEV. L. & POL'Y 4, 6 (2015).
[124] *Id.*

RPSs' competitive bid process, RPSs provide a weaker incentive for renewable energy than originally hoped.[125]

Permitting net metering is another extremely important state policy, as is the related incentive of feed-in tariffs. These affect distributed (i.e. non-utility-scale) energy generation. Together, they are a major contributor to the fact that more than half a million homes in the United States have installed solar panels as of 2014.[126] Net metering programs allow electricity consumers who own solar panels to send excess electricity generation to the electrical grid in exchange for a credit, essentially spinning their electric meters backwards.[127] For example, if a house's solar panels generate more electricity during peak hours of sunlight than the household uses, the extra electricity can be used by other consumers, and then the household can get some or all of that electricity back when there is less sunlight.[128] The customer is then only billed for *net* electricity consumption.[129] Forty-three states and the District of Columbia have programs mandating that utility companies allow net metering; however, as with RPSs, there is a great deal of variation between programs.[130]

Specifically, state net metering programs have a wide variety of how net excess generation is credited.[131] Thirteen states mandate that customers receive credits at or above the retail electric rate, and that those credits do not

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[125] Katherine D. Kelly, *Don't Hide Behind Statutory Roadblocks: How the United States Can Resolve Conflicts to Implementing the German Feed-in Tariff Model and Contribute to International Efforts to Control Climate Change*, 50 COLUM. J. TRANSNAT'L L. 726, 754 (2012).

[126] *Solar Data Talking Points,* SEIA (2014), http://www.seia.org/sites/default/files/SMI%20talking%20points%20Q3%202014.pdf.

[127] Kevin Karges, *Net Metering: Do Non-Solar Homeowners and Utility Companies Have Legitimate Gripe?*, 3 ARIZ. J. ENVTL. L & POL'Y 1017, 1018 (2014).

[128] *Id.*

[129] *Net Metering*, SEIA (last visited Mar. 26, 2015), http://www.seia.org/research-resources/net-metering-state.

[130] *See* DSIRE, NET METERING (2015), *http://csolarcen-prod.s3.amazonaws.com*.

[131] DSIRE, CUSTOMER CREDITS FOR MONTHLY NET EXCESS GENERATION (NEG) UNDER NET METERING (2014), *http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/03/Net-Metering-Policies-Treatment-of-Net-Excess-Generation.pdf*.

expire.[132] In 19 states excess generation is credited at the retail rate first, but the credits expire or are reduced after a set period of time.[133] Finally, in nine states excess generation is credited at less than the retail rate.[134] Clearly, the first type of program provides the strongest incentive for installing a solar energy system. Different states also have varying limits on the sizes of individual solar systems that qualify for net metering.[135] New Jersey is one of the most progressive states in this regard, with no limit on the size of qualifying systems.[136] Perhaps this is why New Jersey has one of the highest amounts of installed distributed solar power,[137] despite having a relatively low solar resource.[138]

Net metering is one of the most important incentives for electricity consumers to install distributed renewable generation.[139] The unique benefits of distributed solar generation include lowering electric bills, decreasing transmission and distribution costs by generating electricity where people use it, and bringing new solar power capacity onto the grid quickly.[140] Distributed generation is also attractive because it requires minimal government oversight and public investment.[141]

Similar to net metering, feed-in tariffs ("FIT") are based on the amount of electricity a non-utility generator sends to the grid — a performance-based incentive for distributed generation.[142] Under most FIT schemes, utility companies must compensate customers who install solar

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[132] *Id.*
[133] *Id.*
[134] *Id.*
[135] *See* DSIRE, NORTH CAROLINA CLEAN ENERGY TECHNOLOGY CENTER, DATABASE OF STATE INCENTIVES FOR RENEWABLES & EFFICIENCY (2015), *available at* http://www.dsireusa.org/resources/detailed-summary-maps/net-metering-policies-2/.
[136] BPU, NET METERING AND INTERCONNECTION (2015), *available at* http://www.njcleanenergy.com/renewable-energy/programs/net-metering-and-interconnection.
[137] *Net Metering by State*, SEIA (last visited Mar. 26, 2015), http://www.seia.org/research-resources/net-metering-state.
[138] U.S. DEP'T OF ENERGY, *supra* note 20, at 35.
[139] Baker-Bransletter, *supra* note 6, at 8.
[140] *Id.*
[141] Karges, *supra* note 127, at 1019.
[142] *Feed-in tariff: A policy tool encouraging deployment of renewable electricity technologies*, U.S. ENERGY INFORMATION ADMINISTRATION (May 30, 2013), http://www.eia.gov/todayinenergy/detail.cfm?id=11471.

panels, or certain other forms of distributed renewable generation, for the excess electricity the customers send to the grid at a premium rate.[143] The rate depends on the technology used, with solar panels typically receiving the highest rate, and the customer usually enters a long-term, stable contract (often 10 to 20 years) for this rate.[144] Under many of these arrangements, the rate of compensation decreases towards the retail rate as the generation from the relevant renewable technology increases in market share.[145]

FITs are widely lauded for the benefits they provide.[146] Proponents argue FITs overcome barriers to increased reliance on renewables that plague other incentive programs, for example by guaranteeing grid access to renewables.[147] Long-term, stable contracts under FIT programs also significantly reduce market risk for what would otherwise be seen as a risky investment; this is arguably the most important benefit.[148] Another advantage is that FITs help solar and other renewable technologies achieve grid parity more quickly by creating more demand for them, which raises production levels.[149] This increases production and installation efficiency, which in turn drives down prices.[150] Furthermore, as the rate of compensation decreases and market share goes up, the burden on utility companies is reduced.[151]

The success of FITs is readily apparent, of which Germany is a shining example, and as a result, as many as 78 countries have implemented some type of FIT program as of 2012.[152] Germany's program has surpassed expectations, causing renewables' share of German electricity production to more than double, four years earlier than the original goal set by the German government.[153] This has resulted in significant reductions in CO_2 emissions

[143] *Id.*
[144] *Id.*
[145] *Id.*
[146] Kelly, *supra* note 125, at 734.
[147] *Id.* at 734.
[148] *Id.* at 735.
[149] *Id.* at 735-36.
[150] *Id.*
[151] *Id.* at 736.
[152] *Id.* at 743-44.
[153] *Id.*

and tremendous economic benefits.[154] Now, Germany is projected to derive a third of its energy consumption from renewable resources by 2020, and to be able to rely entirely on renewables by 2050.[155] This is even more impressive when considering that Germany is a developed, heavily industrialized nation.[156]

However, feed-in tariffs are not perfect, as seen in Spain and a few other countries.[157] Spain provides an example of a poorly implemented FIT, which lead to significant economic problems.[158] As a result, Spain eliminated its FIT by 2013, but not before its FIT made Spain the second largest producer of renewable energy in Western Europe.[159] Rapid growth of distributed generation propelled by FITs also causes substantial grid integration issues, and necessitates revision of an FIT over time, which can reduce market certainty.[160] However, these issues should be surmountable with careful implementation of FITs[161] and increased investment in updating the electrical grid.[162]

Currently in the United States, there is a debate over whether the states or the federal government have the constitutional authority to enact FITs.[163] The Federal Energy Regulatory Commission ("FERC") regulates wholesale electricity sales, including rates, while states have their own areas of jurisdiction over the electric industry, including retail rates.[164] Thus, on one side is the argument that state-level FITs are unconstitutional under the Supremacy Clause because they require states to usurp FERC's exclusive

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[154] *Id.* at 744.
[155] *Id.*
[156] Lincoln L. Davies & Kirsten Allen, *Feed-in Tariffs in Turmoil*, 116 W. VA. L. REV. 937, 940 (2014).
[157] *Id.*
[158] Kelly, *supra* note 125, at 740.
[159] Davies & Allen, *supra* note 156, at 967.
[160] Davies & Allen, *supra* note 156, at 940-41.
[161] Kelly, *supra* note 125, at 740.
[162] Davies & Allen, *supra* note 156, at 940-41.
[163] *See* Michael Dorsi, *Clean Energy Pricing and Federalism: Legal Obstacles and Options for Feed-in Tariffs*, 35 ENVIRONS ENVTL. L. & POL'Y J. 173 (2012); Kelly, *supra* note 125, at 726; Frank R. Lindh & Thomas W. Bone Jr., *State Jurisdiction Over Distributed Generators*, 34 ENERGY L. J. 499 (2013).
[164] Kelly, *supra* note 125, at 748.

jurisdiction to set rates for wholesale electricity sales.[165] The opposing arguments are that it is possible for states to set up FITs under the current regulatory scheme without treading on FERC's jurisdiction, and that FITs do not regulate wholesale electricity sales at all.[166] While a federal-level FIT may be constitutionally permissible, it would have problems with the varied electric markets (i.e. uneven distribution of renewable resources) in different states.[167] As such, state-level FITs are likely more effective.[168]

In 2010, FERC issued an order declaring that California's FIT program impermissibly encroached on FERC's exclusive jurisdiction.[169] At present, that decision constrains the scope of FITs that states can implement.[170] Since that decision, however, California and six other states have enacted new FIT programs within the parameters set by FERC (some of which have now expired).[171] Additionally, various utility companies have voluntarily offered FITs or similar programs in a number of other states.[172]

There is another ongoing debate over which are more desirable: net metering programs or FITs.[173] Those who favor net metering concede that FITs were extremely important in the development of the solar industry, but argue that it is no longer necessary to deliberately overpay for solar electricity, and that FITs cause economic problems.[174] Proponents of net metering and proponents of FITs disagree over which is more stable, and which is "more fair" to customers and distributed generators.[175] While it may

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[165] *Id.* at 749.
[166] *Id*. at 749, 752.
[167] Dorsi, *supra* note 163, at 176.
[168] *Id.*
[169] Kelly, *supra* note 125, at 757.
[170] *Id*. at 763.
[171] *See Feed-In Tariffs and Similar Programs*, U.S. ENERGY INFORMATION ADMINISTRATION (May 30, 2013), http://www.eia.gov/electricity/policies/provider_programs.cfm.
[172] *Id.*
[173] *See, e.g.*, Herman Trabish, *Solar's Faceoff: Feed In Tariff Versus Net Energy Metering*, THE ENERGY COLLECTIVE (Jan. 13, 2014), http://theenergycollective.com/hermantrabish/326831/solar-s-faceoff-feed-tariff-versus-net-energy-metering.
[174] *Id.*
[175] *Id.*

be true that net metering is more desirable in terms of short-term economics, at least to some parties, it is difficult to deny that FITs provide a much stronger incentive for rapid growth of distributed renewable generation.

One final issue which unfortunately affects net metering programs and FITs is the fact that under both, the costs of the incentives are usually born by ratepayers (as opposed to being born by taxpayers, as is the case with incentives like tax credits).[176] This has a regressive effect, in that lower income individuals have to pay disproportionately higher amounts to cover the cost of the incentives.[177] Under FITs, the increased costs paid by utility companies are passed on to all ratepayers via relatively small increases in the retail electricity rate.[178] In Germany for example, households pay an average of roughly $36 more per year on utility bills.[179] However, the retail rate should go back down as the FIT rate decreases.[180]

Net metering laws, on the other hand, allow utility customers who generate electricity to use and benefit from the electrical grid, while also paying lower electric bills.[181] This means that solar customers do not evenly share the burden of the fixed costs of grid maintenance and expansion, requiring non-solar customers to bear those costs through potential rate increases.[182] This is made more problematic by the fact that many ratepayers are stuck as non-solar customers, either because they cannot afford the upfront costs of solar panels or because they have nowhere to put them. However, it may be that distributed generation's inherent benefits to the grid outweigh the reduced monetary compensation.[183] Also, rising costs for utility companies and non-solar customers may simply be a reality of a shrinking customer base.[184]

One potential compromise with regards to net metering, which has been enacted in some places, is to attach a grid maintenance fee to net

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[176] Karges, *supra* note 127, at 1018-19; Kelly, *supra* note 125, at 737-38.
[177] *See* Kelly, *supra* note 125, at 737-38.
[178] *Id.* at 737.
[179] *Id.*
[180] *Id.* at 738.
[181] Karges, *supra* note 127, at 1018-19.
[182] *Id.* at 1019.
[183] *Id.*
[184] *Id.*

metering customers' utility bills, either as a flat fee or in proportion to the volume of electricity sent to the grid.[185] But this is somewhat counterproductive to the goal of expanding distributed renewable generation, because it removes some of the incentive net metering provides. It would be nice to say that utility companies should, as much as possible, simply bear the costs of net metering and FITs in the form of lower profits. But unfortunately, the reality is that the costs of production-based incentives are most likely going to be born either by ratepayers or taxpayers. Since passing the costs onto ratepayers disproportionately affects lower income persons, the costs should be distributed more progressively amongst taxpayers. But, of course, this is politically more difficult to carry out.

One more unique incentive for distributed solar power, operating at state and local levels, exists in the form of Property Assessed Clean Energy ("PACE") programs.[186] After a state government authorizes their existence within that state, PACE programs allow municipal governments to offer property owners lower-than-market interest rates on loans for energy improvements, such as solar panels.[187] The loans are then paid back over long periods through additional property tax assessments, which is offset by lower energy costs.[188] The primary benefit of PACE financing is that it allows property owners to overcome the upfront costs of installing a solar panel system, or other energy improvement, which may otherwise be prohibitively expensive.[189] This spurs more rapid deployment of clean energy technology, as well as economic activity.[190]

One disadvantage to PACE programs is that financing is only available to property owners, not renters, which also means they tend not to benefit those in lower income communities.[191] Also, they are too expensive

[185] *Id.* at 1020.
[186] *See* Michael A. Wrapp, *Property Assessed Clean Energy (PACE): Victim of Loan Giants or Way of the Future?*, 27 NOTRE DAME J. L. ETHICS & PUB. POL'Y 273, 276 (2013).
[187] *Id.* at 276-77.
[188] *Id.* at 276, 280.
[189] *Id.* at 279-80.
[190] *Id.* at 280-81.
[191] *Id.* at 281.

for many local governments to implement and manage.[192] There are also legal barriers and uncertainties surrounding PACE programs, particularly with regard to the relative priority of PACE liens and mortgages in the event of foreclosure.[193] However, PACE financing is relatively new and still evolving, and has the potential to be highly beneficial.[194]

In addition to the above benefits, which are for the most part unique to the state level, there are numerous other federal-level incentives for solar energy and other renewables.[195] These include a wide variety of state-level tax incentives for both commercial and residential solar energy, which operate in a similar manner, and in addition to, the federal tax incentives discussed above.[196] Not surprisingly, some states provide better environments for solar development than others through these various tax incentives.[197] Additionally, there are numerous local-level incentives for solar energy of the various types previously discussed.[198]

Together, the federal, state, and local policies supporting the development and deployment of solar energy production are vital to the growth of solar energy, and ultimately, are vital to combatting global warming.

Obstacles to Solar Development

The obstacles to large-scale solar development are similar to, and result largely from, obstacles to combating climate change. Perhaps the biggest obstacle to mitigating global warming is that it is a classic case of the tragedy of the commons: mitigation will require global cooperation, and any countries that unilaterally act to cut emissions will bear all of the costs of

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[192] *Id.*
[193] *Id.* at 282.
[194] *Id.* at 301-02.
[195] *See* DSIRE, *Programs*, http://programs.dsireusa.org/system/program (last visited Mar. 28, 2015) (containing a database of information on some 2,782 federal, state, and local incentives for clean energy technologies).
[196] *Id.*
[197] *See* DSIRE, *Summary Maps*, http://programs.dsireusa.org/system/program/maps (last visited Mar. 28, 2015) (showing how many incentives each state has, and linking to state-specific lists of those incentives).
[198] *See* DSIRE, *supra* note 195.

doing so, while most of the benefits accrue to others.[199] Aside from the high upfront cost of developing solar and other renewable resources at the required scale, the status quo—the lifestyles and the economies of industrialized and developing nations alike—is currently dependent upon fossil fuels.[200] These economic barriers and interests, namely the industries making huge sums from fossil fuels and cheap energy, have given rise to strong political opposition to solar development and mitigation of global warming.[201] The political barriers can, for the most part, be summarized as a general lack of political will to combat global warming by replacing the current energy infrastructure with solar and other renewables, and a drive in the opposite direction for continued use of fossil fuels.

The lack of political will to heavily incentivize solar and other renewables, and thus combat global warming, is largely due to the fact that such policies have little political capital. For one thing, these are long term issues, and it is human nature to disfavor delayed benefits that require us to make sacrifices in the present.[202] Also, many Americans, including politicians, do not see global warming as an issue, and thus do not think alternative energy sources like solar energy are important.[203] Oblivious to scientific consensus, half of Americans do not think humans are the primary cause of global warming, and two-thirds think global warming is not a very serious problem.[204] Frankly, those numbers are a very serious problem. Public opinion on the matter is in large part due to propaganda-like efforts of

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[199] Richard B. Stewart et al, *Building Blocks for Global Climate Protection*, 32 STAN. ENVTL. L. J. 341, 348 (2013).

[200] *See* Dave Cohen, *Why are we Still Doing so Little About Climate Change?*, OILPRICE.COM (Aug. 13, 2012), http://oilprice.com/The-Environment/Global-Warming/Why-are-we-Still-Doing-so-Little-About-Climate-Change.html.

[201] *See* Marianne Levelle & Matthew Lewis, *Climate change lobbying dominated by 10 firms*, POLITICO (May 20, 2009), http://www.politico.com/news/stories/0509/22723.html.

[202] Beth Gardiner, *We're All Climate-Change Idiots*, THE NEW YORK TIMES (July 21, 2012), http://www.nytimes.com/2012/07/22/opinion/sunday/were-all-climate-change-idiots.html?_r=4.

[203] Gayathri Vaidyanathan, *Big Gap between What Scientists Say and Americans Think about Climate Change*, SCIENTIFIC AMERICAN (Jan. 30, 2015), http://www.scientificamerican.com/article/big-gap-between-what-scientists-say-and-americans-think-about-climate-change/.

[204] *Id.*

the fossil fuel industry and free-market think tanks, who have sought to throw doubt on the science of global warming by claiming that it is a hoax or not anthropogenic, or by downplaying its seriousness.[205]

Partisan politics play a significant role in reducing solar energy's political capital as well: for example, a recent Senate vote on whether global warming is anthropogenic was split along party lines, with about half of the senators maintaining that it is not.[206] Additionally, Americans who vote Republican are less likely to believe in global warming than those who vote Democratic.[207] Finally, the political capital of incentivizing solar and mitigating global warming is further reduced by tenacious lobbying, including campaign contributions, against such policies by those with opposing interests, like utility companies.[208]

This overall lack of political will has meant that the enacted incentives for solar and other renewables are, for the most part, nowhere near ambitious or strong enough, and are often merely of token force.[209] And now, political opposition to such incentives, which limited their scope and potency in the first place, is pushing back and seeking to repeal them.[210] Lobbying entities, such as utility companies, the American Legislative Exchange Council ("ALEC"), and the Koch brothers, are spending millions of dollars in a number of states to attack and roll back Renewable Portfolio Standards and net metering laws.[211] ALEC has drafted model legislation that would eliminate these policies, and pushed it into the legislatures of several states.[212] These legislative efforts exemplify the staunch opposition of the fossil fuel industry. The lack of RPS's and net metering laws in some states, and these efforts to repeal them in others, are a major obstacle to the development of solar energy.

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[205] JAMES HOGGAN & RICHARD LITTLEMORE, CLIMATE COVER-UP: THE CRUSADE TO DENY GLOBAL WARMING 31, 73 (2009).
[206] Vaidyanathan, *supra* note 203.
[207] *Id.*
[208] *See* Levelle & Lewis, *supra* note 201.
[209] *See* Parker-Flynn, *supra* note 123.
[210] Evan Halper, *Koch Brothers, Big Utilities Attack Solar, Green Energy Policies*, LOS ANGELOS TIMES (Apr. 19, 2014), http://www.latimes.com/nation/la-na-solar-kochs-20140420-story.html#axzz2zRBMvGrB&page=1.
[211] *Id.*
[212] *Id.*

ALEC, which has close ties to the fossil fuel industry, has also drafted model legislation that would require public schools to teach the "countervailing scientific and economic views" on climate change, supposedly in the interests of balance.[213] This legislation has been introduced in over 10 states, and has passed in four.[214] Similarly, in Florida, Republican governor Rick Scott has ordered state officials not to use the terms "climate change" and "global warming," even when talking or writing about the subject.[215] Such efforts to downplay or cover up global warming exemplify the political obstacles to mitigating global warming, and thus to developing solar power. They further deteriorate the political climate for doing so, and are themselves symptomatic of the lack of political will to shift to sustainable energy.

Intertwined with this lack of political will, and spurred on by the political opponents of solar energy and environmentalism, is a continued drive for the use of fossil fuels, in increasing amounts.[216] Again, this is largely due to short-term economics.[217] States, and countries around the world, are motivated to exploit available resources by extracting them for local use and exportation, and to use the cheapest available energy.[218] Without considering external costs, fossil fuels are cheap because the infrastructure for use and extraction of fossil fuels is already in place, many states have large deposits of coal, oil and natural gas, and new technologies continue to be developed to extract continually larger amounts of fossil fuels.[219] In states without RPSs, energy generators are not required to produce any energy from solar and other renewable resources, although these states often have other incentives for renewables.[220] Thus, in those states, the only motivation to utilize renewables rests on a combination of altruism,

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[213] Tina Gerhardt, *Wind and Solar Groups Flee ALEC*, THE PROGRESSIVE (Feb. 1, 2013), http://www.progressive.org/wind-and-solar-groups-flee-alec.
[214] *Id.*
[215] Tristam Korten, *In Florida, officials ban term 'climate change'*, MIAMI HERALD (Mar. 8, 2015), http://www.miamiherald.com/news/state/florida/article12983720.html.
[216] Parker-Flynn, *supra* note 123, at 7-9.
[217] *Id.* at 4.
[218] *Id.* at 4, 8.
[219] *See id.* at 7-9.
[220] *Id.* at 6.

reputational incentives, availability of renewables, and in some cases, economics.[221]

Even in states that have RPSs, the vast majority of energy production is allowed to come from fossil fuels.[222] And no state has a meaningful limit with regards to fossil fuels, meaning that use and exportation is permitted to increase.[223] In fact, consumption and exportation of fossil fuels is still incentivized: the federal government and many states, especially those with large fossil fuel deposits, continue to subsidize fossil fuels.[224] This, new technologies, and the fact that there is no limit on fossil fuel use or production, explain why fossil fuel production continues to increase.[225] The United States overtook Saudi Arabia as the world's largest producer of petroleum in 2015.[226] The United States also has more recoverable coal deposits than any other country, and domestic consumption and production is expected to continue to rise.[227] Additionally, natural gas production, the supposed cleanliness of which is doubtful, has exploded in recent years in the United States.[228] As fossil fuel production continues to rise, the sunken costs of newly built infrastructure (e.g. new natural gas plants) ensure decades of massive greenhouse gas emissions and make renewables less economically attractive in the short term.[229]

Thus, an overall lack of political will and a continued drive for fossil fuels present enormous barriers to the goals of advancing solar energy and mitigating climate change.

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[221] *Id.* at 6-7.
[222] *Id.* at 6.
[223] *Id.*
[224] *Id.* at 8; Joseph E. Aldy, *Money for Nothing: The Case for Eliminating US Fossil Fuel Subsidies*, RESOURCES FOR THE FUTURE (last visited Apr. 18, 2015), http://www.rff.org/Publications/Resources/Pages/186-Money-for-Nothing-The-Case-for-Eliminating-US-Fossil-Fuel-Subsidies.aspx.
[225] Parker-Flynn, *supra* note 123, at 7-9.
[226] *Id.* at 8.
[227] *Id.*
[228] *Id.* at 7-8.
[229] *Id.* at 8.

III. COMMENTARY

Free market economics will not foster significant growth of solar and other renewables; it is quite clear that governments must support, and even mandate, their growth. Some government support is in place, which is certainly a step in the right direction. But overall, current subsidies and polices supporting solar energy, and renewable energy generally, in the United States (and in most of the world) are woefully inadequate.

Climate scientists agree that prior emissions have locked us into an average temperature rise of up to two degrees Fahrenheit.[230] They also agree that greenhouse gas emissions must be reduced by as much as 80 percent below 1990 levels by 2050 to keep global temperature increases from becoming catastrophic.[231] The Department of Energy's SunShot Vision Study, which provides an *optimistic* projection for solar energy's contribution to the United States' energy market based on current and forecasted conditions, estimates that solar could meet 14 percent of electricity demand by 2030, and 27 percent by 2050.[232] The study projects that, due to rising electricity demand, this will equate to a mere three percent decrease in annual electric-sector CO_2 emissions from 2010 levels by 2030, and only an eight percent decrease from 2010 levels by 2050.[233] Worse, electricity production only accounts for 30 percent of total greenhouse gas emissions in the United States, meaning that a three percent drop in electric-sector emissions would be less than a one percent drop in total emissions.[234]

Of course, solar energy is just part of the solution, and growth of other renewables will help cut emissions. Innovations such as electric cars will allow things like transportation, which accounts for 27 percent of total

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[230] Mary Christina Wood, *Nature's Trust: A Legal, Political and Moral Frame for Global Warming*, 34 B.C. ENVTL. AFF. L. REV. 577, 580 (2007).
[231] *Id.* at 589.
[232] U.S. DEP'T OF ENERGY, *supra* note 20, at 7.
[233] *Id.* at 63-4.
[234] EPA, DRAFT INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2014 2-24, http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html. Other categories of emissions are transportation, industry, agriculture, commercial, and residential, which present unique challenges in terms of adapting renewable energy sources to replace GHG emissions. *Id.* at 2-24-25.

greenhouse gas emissions,[235] to be powered by renewable energy. But wind generation is expected to grow at a slightly slower pace than solar over the next three decades, hydroelectric generation has remained fairly steady over the past two decades, and other renewable energy sources are not expected to provide significant contributions for some time.[236] Clearly, much faster growth is needed to achieve the drastic and necessary reduction in greenhouse gas emissions.

The laissez-faire economics that many hold dear will not foster significant growth of solar and other renewables, because in reality, free market economics focuses only on immediate costs and profits, instead of long-term externalities. Therefore, the government must support, and will probably have to mandate, their growth. As the SunShot Vision Study suggests, current government policies are doing nowhere near enough to support solar and other renewables. It is imperative that federal and state governments enact much more robust subsidies, incentives, and mandates. Heavily subsidizing renewables, for example at the level of spending by the Department of Defense, would be no different than the trillions of dollars in subsidies spent on other energy sources over the past century, except that it would actually be justified based on the long-term, external costs of energy. While mandating rapid growth of solar and other renewable energy generation might sound radical in today's sociopolitical climate, how can it be radical to do what is necessary to protect the earth and its inhabitants?

Realistically, combatting global warming will require not only replacing fossil fuel consumption with renewable energy, but large scale deployment of carbon-capture technologies, and technologies that capture other greenhouse gases like methane. This would mean a truly global effort, with trillions of dollars of investment in infrastructure that completely revamps the way the human race interacts with the planet. But not only would this create jobs and a sustainable economy, it would secure our future. Just imagine if the amount of effort that was expended on World War II, or other wars, or on exploiting the earth's non-renewable resources, was poured into a long-term investment in the future of the entire human race.

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[235] *Id.*
[236] Parker-Flynn, *supra* note 123, at 9.

This is of course idealistic, and it would require people to actually see that the value of humanity is greater than that of power or wealth. It would require people to recognize that we only have one planet that we all share. While it may be idealistic, it is, without a doubt, necessary. The hardest part of mitigating global warming will not be the investment or technology required to do so, but convincing enough people of the gravity of the situation.

IV. CONCLUSION

Solar energy is a growing, vital source of clean energy. Its benefits lie in its extremely low environmental impacts, its ability to power our world without contributing to global warming, and its versatility, among other things. Mitigating global warming in the next few decades is of paramount importance, and thus, so is the development of solar energy and other forms of clean, renewable energy on a massive scale, because of their ability to help eliminate greenhouse gas emissions. Fossil fuels are, for now, still cheaper than solar and wind installations in terms of short-term economics, but not in terms of external costs. Because the market does not take such external costs into account, however, government incentives are needed to support the development of renewables.

A range of incentives currently exist for solar energy at the federal, state, and local levels. These include tax credits, loan guarantees, renewable energy standards, net metering laws, and feed-in tariffs. Despite this, solar and other renewables are not growing fast enough. This is largely due to the obstacles to their development, including a lack of political will to support renewables heavily enough, and a continued drive for fossil fuels. As a result, incentives for solar and other renewables are, overall, far too weak. If there is to be any hope of averting catastrophic climate change, the current sociopolitical situation must drastically change.