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Leveling the playing field for rooftop solar

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INTRODUCTION

Solar is the most dynamic part of the power sector, combining rapid innovation with explosive growth. The price of solar panels has fallen a remarkable 99 percent over the last four decades and new large solar plants continually set size records and embody a remarkable variety of forms, including "floatovoltaics" (floating solar facilities) and solar thermal plants using parabolic mirrors to capture the sun's energy.[1] More than a million homes in America now have rooftop solar panels installed. In projecting the energy supply of the future, the world is counting on installation of many times more solar capacity than exists today. If solar has not been cost-competitive in the past, there is a widespread faith that it will be in the future.

Getting from here to there is not, as many people imagine, simply a matter of how much the government decides to push solar along. A few jurisdictions are willing to adopt exceptionally heavy-handed mandates to promote solar, regardless of the cost.[2] But more often, solar's recent growth has been supported by a complex mix of subsidies and mandates, even as many features of the regulatory environment are stacked *against* the widespread adoption of solar power, and especially rooftop solar, as technological advances transform it from a protected industry to a level-playing field competitor.

Of course, what it means for solar to compete on equal terms with other kinds of power sources is quite controversial. Intuitively, it seems that it should mean that the price of power for consumers reflects the true costs of generating that power, such that the most cost-effective source will win out.

But that intuition can't take us very far, for two reasons. First, discovering the "true" costs of power generation and transmission is considerably more fraught than it initially seems. Second, focusing only on current delivery costs assumes a one-way flow of power from commercial producers to consumers, when in fact the smart grid of the future will support a far more complex set of interactions between baseload producers, distributed generation producers and storers, providers of "auxiliary services" to the grid, and grid and transmission utilities. Assessing the costs and benefits of particular changes to the grid requires making assumptions about the future shape of the grid, so that there is no neutral meaning of a "level playing field" independent of some vision of how the grid will develop.

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Policymakers considering the many issues affecting solar power should confidently envision rooftop solar playing an important role in the grid of the future and act accordingly. In many cases, that means rejecting intuitive and straightforward cost estimates that effectively lock our present grid configuration into place. It also means reconsidering a regulatory structure that often favors conventional utilities to the detriment of upstart contributors. Technology has changed, so that what was once basically a natural monopoly has now become unnatural. Regulations that made sense in the past now actively stifle innovations that have the potential to leave everyone better off by producing a more environmentally friendly and resilient power grid.

This brief paper explores level-playing-field considerations in three issue areas crucial to the future of rooftop solar: pricing, subsidies, and fees; financing and tax treatment; and building codes, zoning, and regulatory barriers. In each, it shows that homeowners considering rooftop solar encounter features of the legal environment that make investing more difficult. Such discouraging policies ultimately stand in the way of development and ought to be priorities for policymakers to address. Since many of these policies are at the state and local level, they also offer opportunities for improvement even if solar becomes stuck in a partisan morass at the federal level.

PRICING, SUBSIDIES, AND FEES: WHAT IS ROOFTOP SOLAR POWER WORTH?

How much money should a homeowner save when they provide a kilowatt-hour of power from their own rooftop solar panel rather than needing to purchase it from their electric utility? How much should the utility have to pay them if the home is generating more power than it is using, such that it is providing some small part of the power needs of others? Do homeowners relying on their rooftop solar panels free-ride on the services provided by the traditional grid in a way that threatens the provision of reliable power? This section explains why answering these questions is so difficult, and why some of the most intuitive answers unfairly tilt the playing field against rooftop solar.

Our first instinct is to simply look at the average cost of providing a unit of power from one type of source rather than another. By this measure, although it remains more costly than other power sources, solar has a promising trajectory, with utility-scale costs falling by 65 percent since 2011 and residential rooftop falling 57 percent.[3] So, if we were to judge by this metric alone, solar is not yet quite competitive with traditional utilities, but it is on its way to being there. Unfortunately, both utility-scale and rooftop solar have significant shortcomings that average installed cost does not capture because of their variability in response to weather patterns and inability to provide round-the-clock generation.[4]

A somewhat dizzying array of alternative cost measures try to take into account two complicating factors: *reliability*, or the practical differences between solar and traditional baseload resources, and *replacement*, or how the introduction of new resources in place of existing baseload facilities for non-economic reasons (statute, regulation) carry deadweight losses that should be priced into the costs of new resources.[5] Adding in these considerations tends to make solar seems perilously pricy. Partial exceptions include cost measures that integrate avoided costs (costs to the grid of demand otherwise displaced by new resources), which offer a relatively optimistic picture for solar uptake, especially utility-scale, depending on the subsidy outlook.[6] Even these adjusted pricing methods tend to paint distributed rooftop solar as less competitive, though, and thus provide utilities an easier opportunity for resistance to growth in the rooftop solar market.[7]

Balancing the considerations that go into competing cost assessments in a way that gives a single "fair" price is probably impossible. As Peter Fox-Penner put it,

> *"We know that the true cost gap [between renewable power sources and baseload power] is smaller than [it seems] because small-scale sources reduce the need for upstream generation, transmission, and distribution investment. We also know that these avoided costs are hard to measure, require extensive regulatory involvement, and are very site and system dependent. The gap in observable costs highlights the importance of the policies and market structure changes that allow these costs to be measured and reflected in utility supply decisions."*[8]

Understanding these complexities, some forward-thinking utilities have had the foresight to treat the recent (subsidy-driven) boom in residential solar as a glimpse of the grid's future, responding to it as an opportunity for rate redesign and adaptation. Most notable in this vein is New York's Reforming the Energy Vision (REV) strategy, a collaborative effort bringing together the state's major utilities, solar companies, and political leaders in an attempt to move past the standard net metering fights and move toward a rate and regulatory structure that supports a burgeoning solar presence on the grid.[9] But, unsurprisingly, more often existing utilities have tended to focus on the downsides of rooftop solar and fight to preserve their existing business models, which they see as facing a potentially existential threat from distributed generation.[10]

Utilities' concerns about rooftop solar are not without merit, and deserve discussion. Broadly speaking, utilities worry about a baseload death spiral. Rooftop solar in conjunction with net metering (which pays rooftop solar owners for the power they add to the grid) decreases rate-based revenue, while not necessarily reducing utility costs for two reasons: 1) rooftop solar owners still rely on baseload electricity when solar isn't delivering at night or on cloudy days, and 2) net metering transactions, in practice, rely on infrastructure owned, operated, and maintained by the utilities. So while rooftop solar users don't rely on the utility companies for the power they use (or rely on them less than they did before), they still use the infrastructure of the grid, and such use demands the healthy maintenance thereof. Utilities fund the fixed costs of infrastructure via volumetric rates—the more you use, the more

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you pay—and rooftop solar users end up skipping out on these rate-based payments while still using the grid, both in times when their own production is insufficient and when they are selling energy back to the grid via net metering.

Simple mandates for net metering—letting people "run their meters backward," no matter the larger context of usage and infrastructure provision—are thus rather blunt instruments for integrating rooftop solar into a functioning system. Utilities have dubbed this the "cost shift" problem, and see rooftop solar users as free riders who force those that rely purely on baseload resources to shoulder an additional and volumetrically incongruent portion of these fixed costs, regardless of their use habits.[11] They have, at times, transmuted this argument into the language of social justice, for instance allying with the Florida NAACP to oppose that state's solar incentive program by portraying it as a giveaway to wealthy homeowners.[12]

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It is hard to know how seriously to take the threat of a baseload death spiral. The utilities' logic is unquestionably sound, but there are reasons to think that they have significantly overreacted to a threat that is not at all immanent. As one solar advocate put it, their campaign against rooftop solar has sometimes come to resemble "killing a mouse with a shotgun."[13] But actions taken by the Edison Electric Institute suggest that the utilities have gone beyond the realm of rhetoric and even policy by beginning to restructure their portfolios in ways that protect them against a radical transformation of the market, such as investing heavily in utility-scale solar.[14] One could argue that this outcome, in itself, is a success of the technology-forcing nature of solar subsidies.

In any case, it seems wrong to allow fears about the fragility of current economic arrangements to automatically halt evolution of the grid. As my colleagues Mark Muro and Devashree Saha have argued, there are many ways to move toward optimal pricing models that pay a utility based on metrics beyond simple delivery, including system resilience, affordability, and distributed generation integration. Advancing grid technology may itself help move things in this direction by providing a wealth of real-time data and enabling dynamic pricing that will reduce pricing inefficiencies and enable greater precision.

Once one begins to think in terms of a smarter grid, rooftop solar has a great deal to offer to an evolving electricity sector. By mitigating power demand at peaks, rooftop solar makes it easier to deal with summer strains on grid capacity that can sometimes lead to brownouts. Since solar's peak capacity coincides with one of the conditions of peak demand, its efficiency is greater than its raw utilization rate might otherwise suggest. While it may not have the "on-off" switch that traditional resources do, it is at its most serviceable when it is most needed. Electricity generated by rooftop solar also tends to suffer "lower line losses because electricity travels shorter distances between the generator and the end user."[15] And of course in nearly every case, power generated by rooftop solar is displacing power generated by sources that emit both conventional pollutants and greenhouse gases (not to mention their burning scarce and costly non-renewable fuel), improving environmental conditions and limiting climate change.

Utilities are nevertheless correct when they assert that solar is not a dispatchable resource, available on command. But the relevance of this limitation is again a function of the current grid's configuration, which is not best understood as an immutable feature. As electric storage advances, "solar+storage" becomes an especially flexible and valuable participant in balancing the grid, ultimately adding to its resilience by readily providing ancillary services like voltage control, demand-side management, improved power quality, and electricity to critical facilities during major power outages. Arguably, if one gives these benefits their due, solar+storage may already be cost competitive in the current environment.[16] Widespread adoption of "smart" inverters connecting rooftop solar installations to the grid is essential to realizing this vision, as recent tests in Oahu showed.[17] Regulators should think about ways to incentivize and hasten that development.

FINANCING AND TAX TREATMENT

Some of the most important inducements to adopting rooftop solar are implemented through the tax code, at the federal, state, and local levels. The common perception is that tax provisions decisively tilt the playing field in favor of investing in solar, and there is no question that policies working through the tax code have been a major factor working on behalf of the solar industry over the last decade. But lumping tax benefits all together and concluding that all kinds of solar investments are equally advantaged is misleading, and doing so fails to consider many of the regulatory restrictions and barriers that make it more difficult for homeowners (and home builders) to monetize the revenue streams that their installed generating capacity ought to reliably produce for many decades. When thinking about solar investments not in a vacuum, but in comparison to the tax treatment received by other energy production investments, the tax treatment received by solar no longer looks so lopsided. Indeed, there emerge some opportunities for leveling the field through legal provisions that encourage financial creativity.

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Two primary federal tax interventions support solar installation: the investment tax credit (ITC) and accelerated depreciation (Modified Accelerated Cost Recovery System, or MACRS). The solar ITC straightforwardly grants solar installations on both residential and commercial properties a 30 percent federal tax credit.[18] In addition, federal taxpayers may depreciate their solar investments at an accelerated, five-year schedule, meaning businesses may recover investments by taking annual tax deductions over the five-year period following investment. This puts solar investments in the same class as wind and geothermal—but also as investments into oil and gas drilling.[19] Congress has revisited solar's treatment under MACRS several times, particularly by introducing bonus depreciation adjustments in the wake of the 2008 financial crisis. In its current iteration, MACRS provides 50 percent bonus depreciation for solar, meaning that 50 percent of the value can be depreciated in the first year; this bonus depreciation is scheduled to be phased out gradually by 2020.

The consequence of employing these two incentives for solar investment is to attract a few large and sophisticated financial players who are after "tax equity"—that is, whose other business interests put them in a position to reap the full value of the tax deductions thrown off by the solar investments. An impressive $4.5 billion in solar tax equity deals were transacted in 2014.[20] What appears to be a heavy inducement to invest in solar is, in practice, only fully effective where potential investors can find ways of getting hooked up to these sophisticated firms. This ends up favoring commercial-scale solar more than rooftop solar, and large developers of rooftop capacity (who can structure complex arrangements like sale-leasebacks) more than individuals.

Although these incentives through the tax code have undoubtedly been a boon to the solar industry, at this point in time they represent a rather tenuous support—one that is scheduled to be phased out, and is thus subject to the vagaries of the political process in the coming years. The uncertainty introduced not only by the legal status quo, but by the possibility of system-wide tax reform that would wipe away solar's advantages ahead of schedule, means that potential investors are discouraged from taking a long view.[21] Two policy changes could better help keep the long term, and the grid we want to see realized over time, in view.

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First, solar investments increase the value of the properties they are installed on, and they should be treated accordingly by government agencies in the business of valuing property, most importantly Fannie Mae and Freddie Mac. The Bipartisan SAVE Act, introduced as a standalone bill in the 113th Congress and as an amendment to the large (unpassed) energy bill in the 114th Congress, would straightforwardly provide for this change, tasking the government mortgage companies with adopting appraisal regulations that properly value the contribution of efficiency upgrades, including rooftop solar.[22]

Second, local and state governments can look for ways to promote relationships between utilities and potential rooftop solar owners that allow the less-sophisticated homeowners to share in the benefits of complex financial arrangements without bearing the burden of the costs. This does not necessarily entail relying on financial intermediaries. Utilities themselves can act as the sophisticated party, offering to add rooftop solar capacity to a home in exchange for a guarantee of lowered prices while retaining ownership of the panel. This strategy was adopted by CPS Energy, San Antonio's municipal utility, with promising early results.[23] Alternatively, homebuilders can facilitate similar arrangements with a home's first owner, making rooftop solar a standard feature of a new home in a way that guarantees the homeowner reduced energy prices (but that may leave the builder as the owner of the solar unit).[24] In addition to handling the daunting complexities and potential risks of energy pricing, such homebuilders can also tackle another set of issues more effectively and directly: those relating to building codes and zoning requirements.

BUILDING CODES, ZONING, AND REGULATORY BARRIERS

Installing rooftop solar panels on existing or newly constructed buildings is, in the end, a matter of changing our built environment. As such, it is heavily regulated by building codes set by state and local policies—which themselves often rely on the decisions of non-governmental standard-setting councils, such as the International Code Council. In spite of starting from a place of less expertise about complicated grid issues, then, it is state and local officials who are in a position to address ways in which building codes and zoning laws may potentially tilt the playing-field against rooftop solar.

At the extreme, "zoning ordinances and restrictive covenants…may limit siting options or ban the use of solar PV" entirely.[25] Jurisdictions may choose to combat such blunt obstructions with a broad brush, by passing solar access laws that bar any excessive restrictions on solar installations, as 25 states have done.[26]

Then there are a number of straightforward structural questions about the safety of installing solar panels—what kind of frames can reliably support the weight of photovoltaic cells, and how should they be attached to existing structures? And, relatedly, what kind of permits must building owners and installers have in order to undertake this work? What fire safety considerations should govern allowable panel placement? These are mundane issues, and yet they can serve as significant barriers to ordinary people's decisions to pursue installation of rooftop solar. Local governments may understandably prefer to err on the side of safety rather than permissiveness for solar—but this may nevertheless be an error, unnecessarily precluding solar installations that would not impair firefighting nor imperil structural soundness.[27] Many states, like California, have tackled them head-on by offering guidance to their local governments about both the substance of the codes and the best ways to minimize the costliness of permitting.[28] Others would do well to follow their example.

Another issue is interconnection standards: that is, rules governing the electrical connection between the solar energy system and the grid. Over the last two decades, most states have developed interconnection standards, of various comprehensiveness, meant to facilitate rooftop solar installations.[29] But there remains significant room for improvement in removing frictions, either through permitting or needless complexity. When faced with a byzantine process of seeking and waiting for approvals, many prospective solar adopters may be scared away. Adopting over-the-counter permitting, as San Jose has done, or online applications, as Portland has done, can ease these potential burdens.[30]

If these areas have largely come onto the radar of most states, somewhat slower has been the incorporation of the energy efficiency improvements offered by rooftop solar into the efficiency requirements for new construction. There are extensive requirements for HVAC systems, building envelope heat retention and insulation, water heating, and lighting, all designed to ensure that new homes and commercial buildings are responsible consumers of energy. But there is little ability for new homebuilders or others to trade off marginal gains across these different parameters in achieving a whole-building standard. That means that adding solar panels fails to relieve efficiency burdens in other building elements; the added efficiency from rooftop solar is effectively uncredited because of the structure of efficiency standards.

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Much fairer to potential solar adopters would be to move to provable outcome-based standards for new construction, giving builders flexibility to design homes that hit an overall performance standard through a combination of all their features, including solar. This can be accomplished through offering an alternative compliance path (sometimes called "stretch codes") for non-standard design elements, to be demonstrated through post-occupancy measurement.[31] Rather than pre-judging that using a certain kind of insulation or building material must be the way for a dwelling to achieve appropriate energy efficiency, outcome-based standards allow builders to incorporate solar in ways that code-writers may not have foreseen. As of now, just a few jurisdictions offer such compliance paths. Learning lessons from early-adopting jurisdictions, such as Massachusetts, offers a promising way for states and localities to decrease regulatory rigidity and promote solar-incorporating innovation.[32] As rooftop solar systems become more sophisticated, they will generate data about their output that can be shared with regulators, which should make it especially easy for owners to demonstrate that their homes' energy performance meets post-construction performance standards.

Naturally, allowing solar to provide a pathway to efficiency compliance creates political enemies: namely, insulation and building materials companies that prefer codes to insist on achieving efficiency through use of their products. Such interests have consistently pushed against allowing flexibility into codes, but policymakers should attempt to put such concerns into proper perspective and keep ultimate goals in mind.

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