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Offsite ZNE Policy Proposal

Arup and Slate Policy & Design submit this offsite ZNE policy framework for consideration.

Additional submitted attachment is included below.

ZNE Has Left the Building

A policy framework for Offsite Authorized new development

Working Draft — June 2015

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1 Introduction: Zero Net Energy on the Horizon

Governments around the world are pursuing Zero Net Energy (ZNE) standards for new buildings. At the same time, ZNE projects emerging in the marketplace are broadening perspectives on sustainable design. What once seemed impossible now seems plausible: continued growth in the built environment need not be a major driver of greenhouse gas emissions.

California, for example, has set a 2020 ZNE target for residential construction and a 2030 target for commercial construction. With emerging efficiency technologies and dropping photovoltaic (PV) prices, these ZNE goals appear achievable – from a strictly technical perspective – for most new construction projects.[1]

But for many buildings, onsite ZNE targets will remain unattainable. Some buildings will be shaded, precluding the use of solar.[2] Tall buildings will not have enough roof area in relation to floor area. Buildings with intensive energy use will be particularly challenged in reaching ZNE targets.

2 Strategic Objectives

For those buildings that cannot reach ZNE using onsite generation, this paper recommends a sensible offsite alternative.[3] This ZNE proposal seeks to:

- Keep transaction costs to a minimum in procuring offsite energy, helping both building owners and building officials.
- Make it easy for high-density development to comply with a ZNE standard.
- Make efficiency a part of the offsite energy solution set.
- Give utilities a leading role in procuring offsite energy – whether efficiency or renewables – so that offsite resources can be structured to minimize impacts of high PV saturation.
- Align payment for operational energy use – such as plug loads and process loads – with the occupants and managers responsible for those loads.

The central premise of this proposal is that these objectives can best be addressed through a centralized *ZNE Aggregator* to provide offsite energy that meets Zero Net Energy objectives. That ZNE Aggregator could be a utility, an existing energy agency, a new type of entity, or a combination of those three. Whatever the entity, it would need to work closely with the local utility both to deliver the energy and, ideally, to structure the energy resources in a manner that minimizes impacts to the grid.

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1 "The Technical Feasibility of Zero Net Energy Buildings in California," Arup; for PG&E, its partner utilities, and the California Public Utilities Commission (2012).

2 It is a central premise of this paper that onsite generation, in the context of ZNE new construction, will come from rooftop or parking lot photovoltaics. Other qualified onsite generation systems might be used in certain contexts, but if a building does not have sufficient onsite photovoltaic capability, it is assumed that a ZNE policy would then permit the remaining energy to come from offsite resources.

3 The impetus for this paper was an externship sponsored by the authors of Danny Yost, Jr., then a graduate student at the Goldman School of Public Policy, U.C. Berkeley. Yost's paper, "Pathways to Zero Net Energy Use: Examining Off-site Sustainable Energy Credits for New Buildings in California," PolicyMatters Journal (2012), touches on many of the issues addressed here. The ideas in both papers were borne of much collaborative brainstorming.

3 "Offsite Authorized"

Many new buildings will need to be exempted from onsite ZNE requirements. Such buildings are called *Offsite Authorized* in this policy proposal.

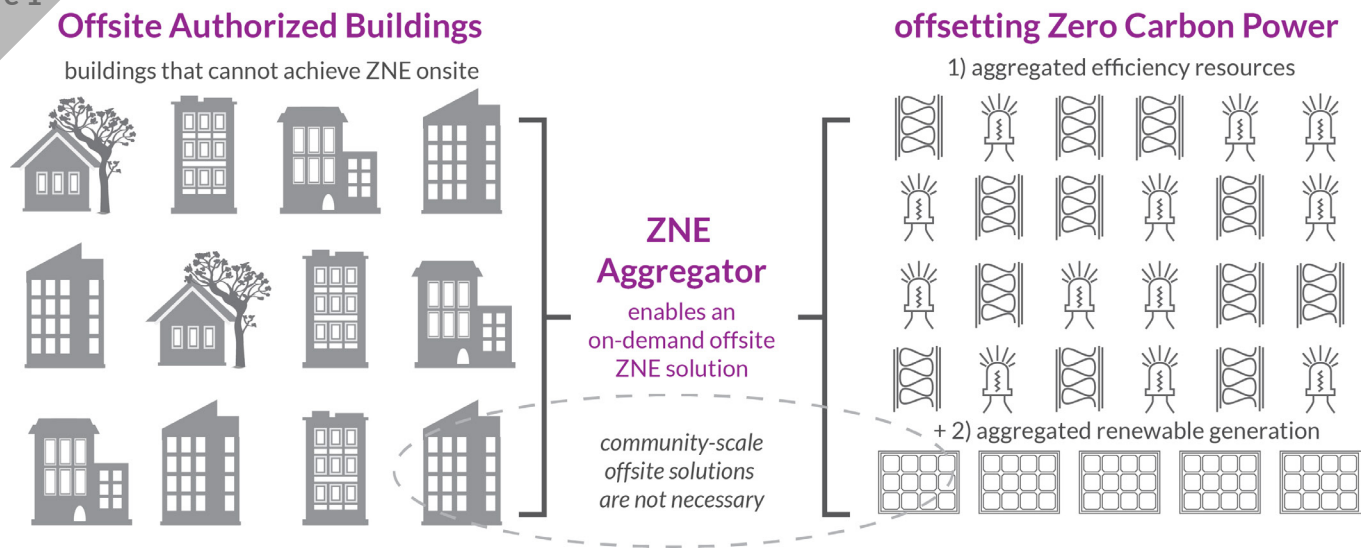
This proposal does not attempt to define which buildings will be Offsite Authorized, but rather suggests the options that should be available to such buildings. Offsite Authorized does not necessarily mean that a building will not have any onsite solar; it means that even after maximizing onsite solar, the building is still not ZNE.

In assessing the potential scale of this policy, it is our estimate that at least 25% of new construction subject to a ZNE mandate would be Offsite Authorized.[4]

4 Offsite ZNE that Works: Proposed Solution

We believe that the most effective framework for Offsite Authorized buildings to achieve Zero Net Energy is through centrally supplied *Zero Carbon Power*.[5] The power would be provided to all Offsite Authorized buildings by a ZNE Aggregator. The Zero Carbon Power would be sourced by the Aggregator from efficiency and renewable resources and delivered to Offsite Authorized buildings – as needed – to meet the actual load of the building. This relationship is set forth in Figure 1.

Figure 1



An Offsite Authorized building would pay for the Zero Carbon Power through a supplemental charge for any electricity or natural gas that is delivered from the grid, additive to the standard utility rates.[6] The additional cost would ideally match the added cost of procurement and distribution for the Zero Carbon Power.[7]

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4 "The Technical Feasibility of Zero Net Energy Buildings in California," Arup, pg 42. The estimates in the "Technical Feasibility" report do not consider shading issues.

5 The power will never be truly zero carbon, but will be delivered consistent with RPS standards or efficiency portfolio standards.

6 The surcharge would be supplemental to standard tiers, where there are tiered rates.

7 The cost should include a profit margin for regulated private utilities, consistent with standard practices for that utility.

Advantages of Using a ZNE Aggregator:

4.1 Minimized transaction costs

Transaction costs can easily undermine an otherwise sound ZNE policy. An ideal policy will keep transaction costs to a minimum for both building owners and local permitting agencies. A standardized system for procuring Zero Carbon Power is the best way to make this happen.

In contrast, if case-by-case contracting arrangements are required for offsite power for each ZNE building, it will create a significant burden on the building industry. And the transaction burden would not merely be contractual: case-by-case offsite solutions would likely need to encumber the ZNE property *itself* and encumber the offsite PV system *itself* for decades to come. This linkage between two properties would necessitate complicated deed restrictions because it would be tied to the property, not to the owner or occupant of the property. Reviewing and approving such deed restrictions to ensure that they fulfill a ZNE regulatory mandate would be cumbersome for local jurisdictions. And the direct pairing of different properties through deed restrictions – to link the offsite solar assets – could impede future transactions for either piece of property.

Creating a far easier path to ZNE, Zero Carbon Power would be supplied to buildings, by default, when an Offsite Authorized building is permitted under a Zero Net Energy policy. The transaction costs would be close to zero for the developer and the building department. The ZNE Aggregator and cooperating utility (if the utility is not itself the Aggregator) would have transaction costs in procuring and managing the Zero Carbon Power, but those offsite production and delivery costs are somewhat inevitable under any compliance regime.

4.2 Bringing efficiency forward as an offsite resource

Conventional thinking for ZNE policies suggests that when *onsite solar* cannot provide sufficient energy to match a building's load, then *offsite solar* should be procured to meet the remaining energy needs of a building. Community solar is often cited as a likely resource.

Once a building is Offsite Authorized, and therefore the solution-space for achieving ZNE leaves a property's boundary, there is no fundamental reason that energy delivered through efficiency investments cannot be used instead of energy delivered through solar. Investing in efficiency to meet offsite energy needs would follow loading order principles: first procure efficiency, then renewables, and finally conventional generation. (Because these buildings need to be ZNE, conventional generation is not an option.)

The logistics of aggregate efficiency procurement are well established in states or countries that are likely to adopt a ZNE mandate. Aggregate procurement is particularly well suited to bring efficiency resources into the offsite solution set. Specifically, while the savings of any single efficiency project can be difficult to measure, the overall savings of a wide-scale efficiency program can be reasonably well estimated.[8] In this sense,

8 As a rough approximation in California: offsetting the unmet loads of Offsite Authorized residential buildings might require a $5M / year investment in Zero Carbon Power, with that investment scaling accordingly each year, requiring a $50M annual investment in efficiency after 10 years, etc. Offsetting the Offsite Authorized commercial loads might require a $10M annual investment, aggregating to $100M / year after 10 years, etc..

using a ZNE Aggregator solves two problems: it streamlines the compliance process and opens the solution-set to offsite efficiency.

A ZNE Aggregator procuring efficiency resources would likely be a centralized authority that is already established to acquire efficiency and/or renewable assets at scale. Such entities are, in most states, the utilities, but other entities can fulfill the same role. The funds provided by the supplemental charge for Zero Carbon Power would become, in essence, additional funding provided to a state's efficiency portfolio. That funding would be used to reduce energy consumption in measurable ways at offsite projects in an amount equivalent to the demand for Zero Carbon Power (when combined with the ZNE Aggregator's offsite renewable resource).

4.2.1 Ensuring that efficiency investments supplement existing programs

For the offsite efficiency investments to truly offset the additional load of Offsite Authorized buildings, the energy secured by such investments would need to supplement – rather than supplant – the existing efficiency portfolio. (In the same manner, the ZNE Aggregator would likely need to ensure that renewable resources are supplemental to the Renewable Portfolio Standard.)

While there are a number of ways to meet this objective, we think the question is best left to implementation discussions. At a minimum, the efficiency procurement program would likely have a higher cost-effectiveness threshold than standard efficiency programs. The baseline cost against which Zero Carbon Power investments should be compared would be the cost of rooftop generation, rather than the cost of new conventional generation.[9] Since the cost effectiveness threshold for Zero Carbon Power would be a modest amount higher than that for conventional efficiency (perhaps $0.15/kWh instead of $0.12/kWh), the Zero Carbon Power program could be structured to not directly compete with the standard efficiency procurement program. This would ensure that the Zero Carbon Power supplied to Offsite Authorized buildings is truly additive.

4.2.2 Turning to efficiency to minimize grid impacts

The importance of efficiency as an offsite energy source – when the primary alternative is PV – will only grow as the overall concentration of solar energy on the grid increases. This increase in solar energy will come both from utility scale solar and rooftop PV resources (driven in no small measure by ZNE mandates). The increasing concentration of solar energy will strain on the utility grid in a number of ways, from ramp rate issues to voltage fluctuation concerns. If efficiency can be procured instead of renewables to fulfill the outstanding requirements of an Offsite Authorized building, the grid impacts of any ZNE policy can be reduced. Flexible efficiency measures – such as demand response – can be especially valuable to the grid.

Critically, where utilities can fill the role of ZNE Aggregator, they will have the ability to procure Zero Carbon Power in a manner that best complements their overall grid management strategy.

4.2.3 Offsetting natural gas use with natural gas efficiency

One challenge with most ZNE policy proposals is that onsite natural gas usage must be offset with electricity production from PV.

If Zero Carbon Power is "generated" through offsite efficiency investments, natural gas usage in a ZNE building could actually be offset by natural gas savings at another

9 This cost effectiveness reference point is known as the Market Price Referent in California.

location. This would happen if the ZNE Aggregator focused a portion of its efficiency investment on reducing natural gas consumption in existing buildings, whether commercial or residential. The natural gas offset need not be precisely one-to-one, but the fuel loads and corresponding offsets can be matched far better with efficiency than would be the case with an offsite solution built purely of PV electricity generation.

4.3 Fiscal parity of offsite energy

This proposal provides an easy-to-access offsite resource for ZNE compliance. By smoothing the compliance pathway for Offsite Authorized buildings, there is less likelihood that a ZNE mandate would need to wholly exempt solar-constrained buildings from meeting the ZNE mandate (i.e. such buildings would not need to take action external to the property boundary). Such an exemption would not only undermine the environmental objectives of a ZNE policy, it would complicate day-to-day administration by providing *too much incentive* for projects to try to become Offsite Authorized. Building officials could be swamped with claims for exemptions where none should be given.[10]

To avoid this problem, Zero Carbon Power should match onsite PV resources in overall expense, leaving a building owner largely neutral, from a fiscal perspective, as to which pathway they follow for ZNE compliance. In other words, there should be no notable windfall from becoming Offsite Authorized.[11]

Cost parity will help with broader ZNE implementation issues. While the regulatory rules allowing a project to be Offsite Authorized are yet to be determined, we have some confidence that the regulations will involve complicated exceptions. The exceptions are also bound to be ambiguous, for example: "Will there be shading on the property within the next 10 years?" If offsite resources have parity with onsite resources, there will be less controversy in developing necessary exceptions. Controversy will be avoided because most stakeholders will see onsite and offsite options as essentially equivalent.

The price paid for Zero Carbon Power would, ideally, be commensurate with the levelized cost of energy from rooftop solar. Emerging community solar options provided by California's Investor Owned Utilities provide a template for such a program – albeit using only offsite solar. Those offerings are expected to be about $0.03/kWh more expensive when compared to conventional electricity.[12]

4.4 Continuing incentive to conserve

An Offsite Authorized building that purchases Zero Carbon Power from a ZNE Aggregator will have stronger economic signals tied to energy use when compared to a building that fulfills its ZNE mandate through the upfront purchase of solar assets

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10 It will not merely be the volume of claims, but the technical challenge for building officials in evaluating each such claim. The first challenge will be in assessing the validity of each building's energy model. Those models are built upon thousands of assumptions, many of which are quite opaque to anyone other than energy modeling professionals. Those models form the foundation of a permit stage ZNE evaluation. The second challenge will be in assessing how much PV capacity can reasonably be installed on the property – an analysis that is bound to encompass a wide range of exceptions, many of them likely to be ambiguous.

11 For this cost parity to influence permit-stage decision making, there is a need to notify project teams that their Zero Carbon Power will be priced at a modest premium compared to standard energy supplies.

12 "New utility-driven community solar program takes shape in California," Debra Kahn, Environment and Energy Publishing (2015).

(whether onsite or offsite). Under this proposal, each Offsite Authorized building needs to purchase only as much Zero Carbon Power as it uses. The need to pay for each additional kWh or therm will give an Offsite Authorized building owner an incentive to continually conserve energy.

4.4.1 Match energy purchases to energy users

As a general rule, the party that controls a given amount of energy use should bear the cost for procuring that energy.

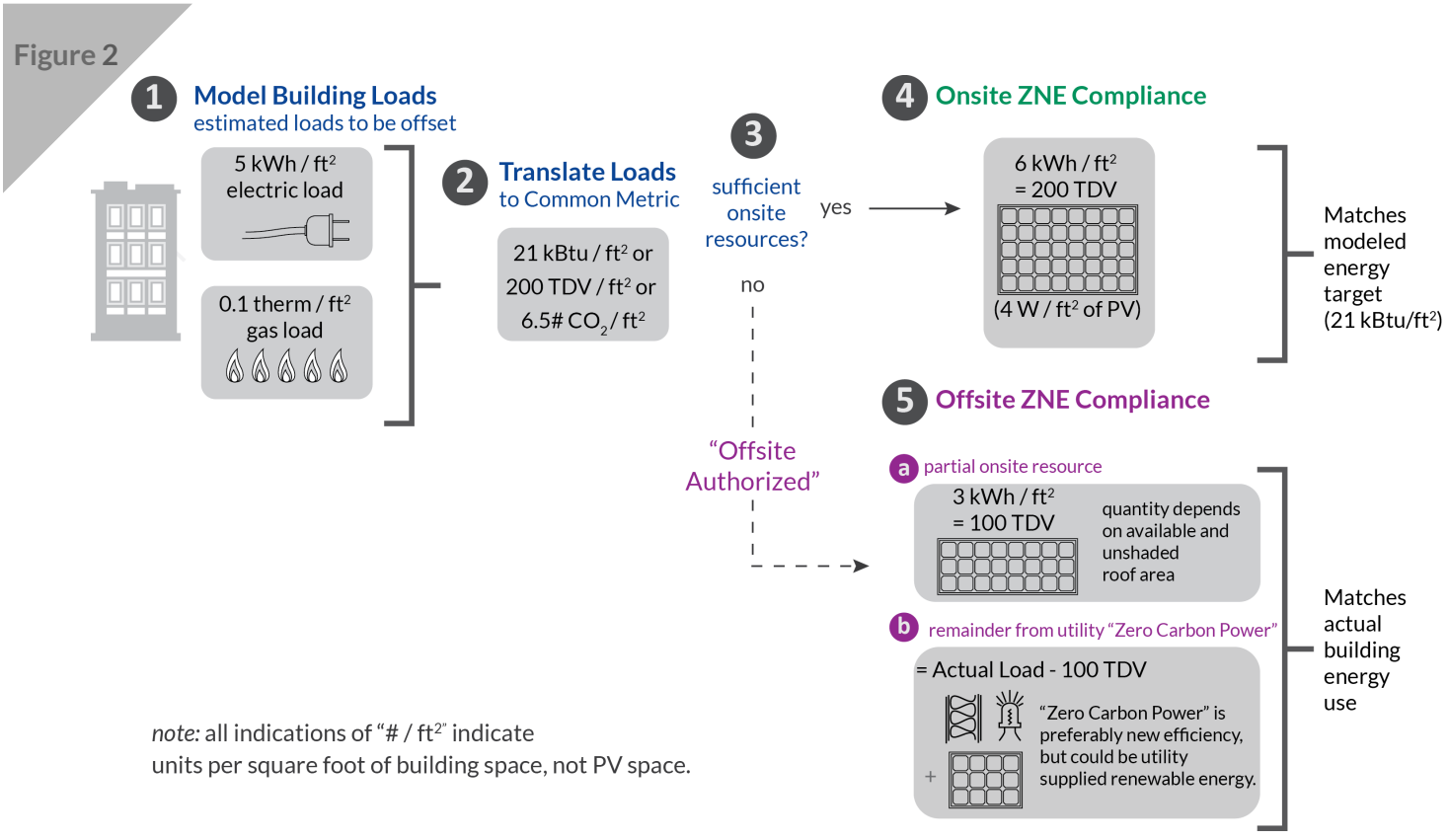
Plug loads and other non-regulated process loads present a challenge to Zero Net Energy goals, as do the building loads created by differing usage intensities. Such loads can vary widely, and they are largely controlled by occupants, far beyond the influence of the engineering and construction teams responsible for energy code compliance.

As compared to a fixed offsite solar asset purchased by a developer (e.g. a standard community solar solution), Zero Carbon Power presents a better policy alignment for offsetting much of a building's energy use, particularly the unregulated energy use. While the policy proposal outlined here does not create a 1:1 match between control and cost, it creates a better alignment than is contemplated by developer-acquired offsite solar solutions. We believe this is the best possible alignment between control and cost while still prioritizing onsite solar when such capacity is available.

5 Implementation at the Scale of One Building

Each new building that enters the permitting process would use the sequence outlined in Figure 2 to comply with this ZNE policy. In Step 1, the likely energy use of the building is estimated using standardized energy modeling protocols. These energy estimates include both electricity and natural gas.

Figure 2



note: all indications of "# / ft²" indicate units per square foot of building space, not PV space.

In Step 2, the electricity and gas consumption estimates are converted to a single metric. In Europe, this is likely to be equivalent carbon emissions. In much of the United States, it would be site Energy Use Intensity (EUI in kBtu/ft^2/yr), and in California it will be Time Dependent Valuation (TDV)[13]. The different fuels must be consolidated to a standard metric since, as a general rule, only onsite electricity generation (through PV) will be used to offset the estimated load.[14]

Once the annual energy load is aggregated to a common metric, an assessment is made (Step 3) as to whether sufficient PV can be installed on the roof or in the parking lot (Step 4) to offset the load. As noted, any jurisdiction that adopts a ZNE policy would likely need to set rules as to when onsite PV has been maximized (e.g. 70% of available roof space and 30% of available parking lot space), thereby defining when a building becomes Offsite Authorized (the "no" path at Step 3).

If the answer is "no," there is not sufficient space for onsite PV, then the building would be Offsite Authorized and directed to Step 5. Step 5(a) requires that the building install PV onsite up to regulatory minimums (once again, likely to be a prescribed amount of roof space and parking lot space). For a high-rise building or a heavily shaded site, the regulatory minimum could well be zero.

Then the compliance path moves to Step 5(b), where the building would enroll in a Zero Carbon Power program with the local utility and ZNE Aggregator (which might be the same entity). The Zero Carbon Power program would be implemented, from the perspective of the building occupant, as a surcharge on each month's energy bill. Because Step 5(b) is scaled based on the net energy use that moves through each building's meter, the surcharge in Step 5 scales every month to the actual energy use of the building. (In contrast, the standard onsite solution in Step 4 scales, upfront, to the estimated energy use set forth in a building's design-phase energy models.)

6 Alternate Offsite Solutions

There are other offsite options that are technically feasible but create logistical challenges either at the permitting stage or in long-term management.

6.1 Offsite generation

Community solar offers the potential for several building owners to buy into aggregated offsite generation. But the lack of consistent contracting and accounting mechanisms will make it difficult for building inspectors enforcing ZNE standards to confirm that energy generated by a specific community solar facility will actually offset a given building's estimated energy use for decades to come. Renewable Energy Credits (RECs) provide a straightforward enough mechanism for offsets, but could be difficult for building officials to validate. Also, unless implemented through the utility, RECs would not easily scale to the amount of energy actually used by a building. If they are used

13 "Defining ZNE Buildings and ZNE Building Goals in California," presentation by Cathy Fogel, CPUC, and Martha Brook, CEC, at the July 18, 2013 "IEPR Workshop on ZNE". For an explanation of TDV, please see "Time Dependent Valuation of Energy for Developing Building Efficiency Standards." Energy and Environmental Economics, 2011, for the California Energy Commission.

14 Solar thermal systems that produce hot water are often considered an efficiency measure for energy code compliance purposes, and therefore would be accounted for in Step 1 in this process. Whether assessed in Step 1 or Step 4, the result will be the same for determining if a building is Offsite Authorized.

by the ZNE Aggregator to supply Zero Carbon Power, they become part of the overall methodology described here.

Most of the offsite solutions raise challenging issues of chain of custody: how do you tie the offsite generation to a new building in a permanent way when it is not physically attached to that building?

Under this proposal, any Offsite Authorized building will necessarily have a utility bill, and bundling the ZNE solution into that utility bill – with the assistance of utilities and the ZNE Aggregator – is the simplest path to achieving ZNE objectives for building sites that are solar constrained.

6.2 Location-based ZNE credits

One promising mechanism for helping Offsite Authorized buildings comply with ZNE requirements is to provide offsetting energy credits to those buildings that are likely to have a reduced energy impact from transportation given their particular location (sometimes called *location efficiency*). Considering transportation impacts as part of a building's energy budget is theoretically valid, yet it entails practical challenges. Proximity to mass-transit is easy to determine, but does not necessarily correlate with transit use (e.g., an office building could have several bus stops nearby that are only rarely used).

A sound approach to location-based ZNE credits would involve calculating the average transportation related carbon emissions per person based on an analysis of actual transportation patterns. The data might be at a zip code scale at first, but census track scale could be better. Those emission rates would be calculated separately for businesses and residences.[15]

Using location-based credits should not be a part of any initial ZNE policy deployment, as the issues involved are likely to distract from core ZNE challenges and opportunities. Hopefully, the comparative simplicity of the offsite solution proposed here will make such location credits helpful, but not essential, to deploying an effective ZNE policy.

6.3 Critical distinction as regards voluntary ZNE projects

Simply put, strategies used for a voluntary ZNE objective have little bearing on what will work well for a regulatory ZNE standard. In a regulatory context, the volume is orders of magnitude higher, compliance issues are paramount (both design-phase and long-term), consistent methodologies are a necessity, and regulators must anticipate a host of secondary impacts. Further, the building occupants are likely to be passive participants in pursuing ZNE rather than standard bearers for a new paradigm.

While much can be learned from the voluntary projects that will predate ZNE regulations, solutions that have worked in a voluntary context will not, by default, work well in a regulatory regime.

7 Optional Policy: Opt-In to Zero Carbon Power

This policy framework could be a helpful strategic option for buildings that are not explicitly Offsite Authorized. In short, such buildings would commit to buy Zero Carbon

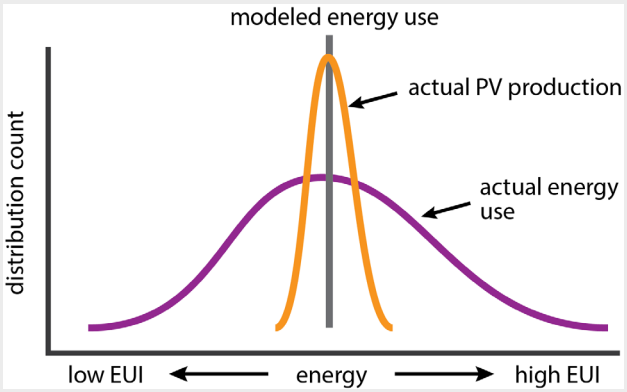
15 A more in-depth discussion of using transportation energy in a ZNE context is presented in "A New Net Zero Definition: Thinking outside the Box," David B. Goldstein and Jamy Bacchus, NRDC (2012 ACEEE Summer Study on Energy Efficiency in Buildings).

Power in exchange for having greater freedom in sizing the rooftop PV system for a building.

7.1 The challenge

Buildings are exceptionally varied in their attributes, their usage patterns, and their energy outcomes. Yet most ZNE policies, as presently conceived, treat the prospective energy use of a building as a known quantity, to which a fixed amount of PV can be assigned to make the building ZNE. This perspective is borne of the need to establish standardized compliance criteria before a building is even built. Those compliance criteria use energy models that can be adapted in some parameters, but must use fixed assumptions for other parameters (e.g. regulations dictate standard plug load densities and standard occupancy schedules for purposes of running a compliance model).

Figure 3



ZNE is generally assessed during the design phase, with a "pin-point" estimate of future energy use (aka modeled energy use). PV systems can be fairly accurately sized to meet that projected energy use. But, even for a series of buildings where the modeled energy use is the same, actual energy use can be quite varied.

For decades, those standardized simulations have been used, appropriately, to compare the merits of efficiency measures. But with the emergence of ZNE policies, those simulations are now being asked to estimate actual future energy usage (not just comparing efficiency benefits). That estimation is needed so that a building's photovoltaic installation can be appropriately sized to reach Zero Net Energy. In this context, an energy simulation will produce a single number estimate when, in reality, a building's energy use could vary widely above or below the projection.

On the other hand, a photovoltaic system will produce a more predictable amount of energy. This discrepancy between the wide spread of actual energy use and comparatively narrow spread of PV production means that very few ZNE buildings will generate energy from PV that closely matches their actual energy use. About half of ZNE buildings will produce more energy than is needed, and half of ZNE buildings will produce less energy than is needed.

7.2 Opt-In proposal

To accommodate buildings that are expected to use less energy than "average," it might be prudent to allow building owners to opt-in to the Offsite Authorized pathway even if they have sufficient space for PV capacity onsite. This approach would involve two components:

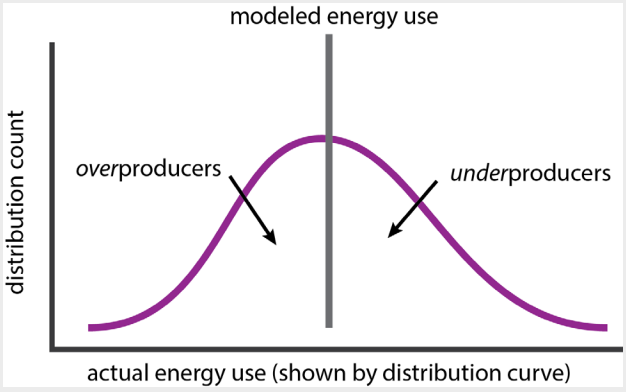
1 — ***Flexibility is granted***: First, such a project would be allowed to adjust its energy models to match expected building performance for purposes of sizing the required PV system. This modeling process would be distinct from the model

used for complying with the efficiency standards (which need to use standardized assumptions). The customized energy model used to size the PV system might predict lower energy consumption than the standard compliance model.[16] Although these two energy models would be different, both models would be accurate for their intended purposes.

2 — ***A reciprocal commitment to use Zero Carbon Power***: Second, in exchange for this flexibility in modeling future energy usage – and therefore in sizing the PV system – the building owner would need to opt-in to the Zero Carbon Power source supplied by the local ZNE Aggregator.

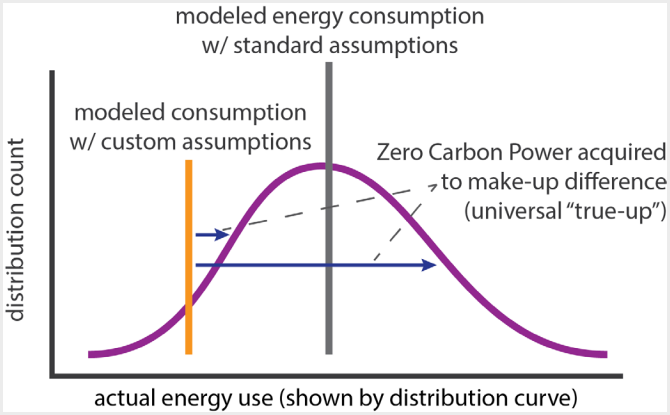
In this scenario, the building would still need to install solar, since the energy model used for PV sizing would never reach zero. There would, however, be less risk of overproducing renewable energy onsite. (See Figures 4 and 5 for more explanation).

Figure 4



With a PV system appropriately sized to make a building ZNE, perhaps half of the ZNE buildings will be producing more energy onsite than they actually use.

Figure 5



A building project could decide to use the compliance pathway outlined for Offsite Authorized buildings. The building would install a level of PV that matched a more conservative estimate of energy use, and in return all energy supplied to the building would come from Zero Carbon Power. This would create an automatic true-up mechanism for any undersizing of the PV system, matching actual energy use.

7.3 The benefit for building officials

If it is prudent to allow PV systems to be sized based on customized modeling assumptions, this policy proposal will reduce the burden placed on building officials to validate such models. Validating energy models can be a challenging task even for

16 As a practical matter, there would be no need to use this compliance path when the PV sizing model estimates more energy use than the standard compliance model.

professional energy analysts. Projecting future occupancy patterns in a given building for 10-20 years – or projecting plug-load densities for 10-20 years – is basically impossible.

This opt-in pathway for using Zero Carbon Power mitigates that problem by providing a long-term, failsafe response to inaccurate modeling estimates. Once a building is operational, any energy that is used by the building beyond the onsite PV production will necessitate the delivery of Zero Carbon Power. That Zero Carbon Power will automatically fulfill the state's broader ZNE goals. In this manner, discrepancies between the PV sizing model and actual energy usage are corrected in real-time, based on metered net consumption, without any up-front technical disputes.

As noted for the primary Offsite Authorized proposal, buildings that use this compliance approach will have a greater incentive to conserve energy since excess energy must still be purchased whenever it is needed, creating a stronger link between marginal energy use and marginal energy costs.

8 Conclusion

Zero Net Energy new construction policies are bold, even inspirational. For many buildings, the ZNE targets should be quite achievable. But for such policy objectives to be enforced at scale – to be applied to all new construction – there are a host of complicated scenarios that need to be addressed. Those scenarios are not simply edge cases, but circumstances that could arise on 25% or more of all ZNE projects. Given the scale of potential offsite ZNE challenges, a workable offsite policy is critical.

This proposal sets forth a sensible ZNE policy for those buildings that do not have sufficient available space onsite to meet standard ZNE requirements. It is our hope that by providing a simple and fair process for helping Offsite Authorized buildings comply with ZNE goals, the whole of an effective ZNE policy will be easier to adopt and easier to implement. Such a policy will encourage, rather than impede, low-carbon development patterns as the built environment continues to grow.