DOCKETED

Docket Number:	15-IEPR-05
Project Title:	Energy Efficiency
TN #:	204653
Document Title:	Jack Ellis Comments: May 18, 2015 Staff Workshop on Zero Net Energy for Newly Constructed Buildings
Description:	N/A
Filer:	System
Organization:	Jack Ellis
Submitter Role:	Public
Submission Date:	5/19/2015 10:19:45 AM
Docketed Date:	5/19/2015

Comment Received From: Jack Ellis
Submitted On: 5/19/2015
Docket Number: 15-IEPR-05

May 18, 2015 Staff Workshop on Zero Net Energy for Newly Constructed Buildings

Additional submitted attachment is included below.

Docket Number: 15-IEPR-05

Project: Energy Efficiency

Subject: May 18, 2015 Staff Workshop on Zero Net Energy for Newly Constructed Buildings

Title: Comments of Jack Ellis

Introduction

I have more than 40 years of energy industry experience. My involvement with California's energy industry goes back to 1979. Over the course of my career I have undertaken a variety of projects for clients and employers that include power system planning and operations; new technology assessment; wholesale electricity market design, implementation and operation; demand response; and renewables policy, implementation and operation. My comments will focus on some of the practical aspects of the Zero Net Energy (ZNE) initiative that the Commission and Staff may or may not be aware of.

Summary

The Commission should pursue the energy efficiency-related elements of ZNE, but with a view toward being minimally proscriptive and recognizing that one-size-fits-all requirements will not work everywhere.

The element of ZNE that requires on-site generation raises a number of ratepayer equity concerns that could slow adoption and undermine public acceptance.

Any paths to compliance with the on-site generation requirement need to consider the costs and practical difficulties of deployment.

The on-site generation requirement depends on Net Energy Metering (NEM). Buyers of ZNE buildings that are required to install on-site generation will face additional costs that are as-yet unknown to help defray the cost of the generation, transmission and distribution infrastructure that allows NEM to work.

The on-site generation requirement will adversely impact grid reliability.

Energy Efficiency

The Commission has acknowledged the importance of ensuring that the energy efficiency-related elements of ZNE are cost effective. However the Commission should set standards based on metrics like energy use per square foot or energy use per occupant and resist the temptation to be overly proscriptive with respect to what a builder must and must not do. My wife and I built a new home in Tahoe City (climate zone 14) five years ago and our experience illustrates why one-size-fits-all directives aren't necessarily practical or useful:

- We intended to install tankless water heaters until we learned they perform poorly when the water supply temperature is too low, as it is up here in the mountains.

- Title 24 required us to install fluorescent outdoor lighting. It works fine from late spring to early fall, but it does not work well in cold weather.

- Although it wasn't required by code at the time, we used better quality insulation that was less susceptible to poor installation practices to ensure long-term performance, and we had gaps in the framing sealed to minimize unwanted air infiltration. We determined that in spite of its superior properties, sprayed in foam insulation was not worth the additional cost, even in light of the then-current natural gas prices.

It's not enough to require certain measures. Building owners and occupants need to know how to use them properly. For example, we installed radiant heating in the floor, with separate, simple thermostats in every room that allow us to appropriately control the temperature in unoccupied rooms. Programmable thermostats were added later to rooms that are only occupied during the daytime. However we've determined that the single most effective way to minimize our our heating costs is to set the hot water temperature as low as possible in order to maximize heat transfer efficiency and minimize cycling. In order to properly leverage the value of energy efficiency investments, the Commission needs to ensure that stricter building codes are accompanied by better owner/occupant education.

ZNE's On-Site Energy Requirement and "Ratepayer" Equity

While it is not uncommon for customers located in new housing and business developments to indirectly pay the cost of distribution system upgrades, I am not familiar with any jurisdiction that require customers to shoulder the initial cost of generation infrastructure. Intended or not, to the extent the on-site generation requirement adds significantly to the price of a new building, it could price marginal buyers out of the market and slow the pace of construction for new, low cost housing. Moreover, according to recent survey data, the installed cost of rooftop solar is roughly twice the installed cost of utility-scale solar[1], which further disadvantages those looking to build a new building or buy a new home.

Furthermore, while ZNE will make new buildings roughly energy self-sufficient over the course of a year, it won't mean owners of ZNE buildings can eliminate their energy bills. As I explain below, ZNE is impractical without NEM, and NEM is impractical without access to transmission, distribution and generation infrastructure. Simple economics dictates that owners of ZNE buildings will have to pay a share of the cost of building, maintaining and operating this infrastructure through some sort of fixed monthly fee, and that the size of that fee is very likely to be significantly larger than the current

[1] "Photovoltaic System Pricing Trends", National Renewable Energy Laboratory and Lawrence Berkeley National Laboratory, September 22, 2014, slide 4 (http://www.nrel.gov/docs/fy14osti/62558.pdf).

differential between the amortized monthly cost of a suitable rooftop PV installation and the otherwise applicable electricity utility bill[2].

Practical Difficulties with ZNE's On-Site Energy Requirement

While it may be theoretically possible to install enough on-site renewable energy capacity to meet a building's annual energy needs, there are impediments that may make it impractical:

- In urban areas, the amount of available roof space may not be adequate, particularly where part of the roof is shaded by adjacent buildings or trees.
- An alternative method of compliance that relies on community energy facilities may be impractical or prohibitively expensive if nearby open land is scarce, as it will be in urban areas.
- In certain rural areas like the Lake Tahoe Basin, there is very little suitable open land for community energy storage and local regulations place strict limits on cutting down live trees.

Moreover, cutting trees to accommodate rooftop solar in any part of the state has certain arguably negative consequences, including lower CO2 absorption and a reduction in heat island mitigation.

ZNE's On-Site Energy Requirement and Net Energy Metering

Because ZNE has an annual time horizon, the on-site energy requirement isn't practical or economically viable without some form of NEM. Seasonal storage, primarily in the form of batteries that may be located on-site or off-site, is currently far too expensive for the amounts of surplus renewable energy production in summer months that would have to be captured and held for use during the winter months, and there is no assurance that costs will fall far enough fast enough to make seasonal storage viable in the foreseeable future. The same currently holds true for diurnal storage. Simply capturing surplus production during the day for night-time use would effectively more than double the cost of on-site energy production at current prices[3] for rooftop PV and storage.

NEM depends on existing utility-owed transmission, distribution and generation assets, plus some portion of the third-party generating assets that are dedicated to utility use under purchased power and resource adequacy agreements. The precise share of these costs that should be borne by customers with ZNE buildings will be determined by the CPUC but it is unlikely that a fee equal to the current differential between a monthly bill for the required amount of PV and a monthly bill from one of the IOUs for an equivalent amount of electricity will be adequate. Consequently, owners of ZNE buildings are likely to face higher costs, and perhaps significantly higher costs, than a neighbor who lives in an

[2] I assume an average electric rate of 21 cents per kWh, average household electric consumption of 8,000 kWh per year, a 5 kW rooftop system with an installed cost of $17,500, and a 30 year loan at 7% interest. Under these assumptions, a rooftop PV system costs approximately $117 per month while the corresponding average electric bill is $140/month. The difference would yield annual revenues of approximately $3 billion for the residential customer class. Electric rates were derived from the current proposed decision in CPUC docket R.12-06-013.

[3] I estimate a 5 kW system would require at least three and perhaps as many as four of Tesla's recently announced Powerwall systems, each of which has an installed cost of about $7,000.

otherwise identical but older building, even though the ZNE building may use less energy over the course of a year.

Moreover, if rooftop PV has to be curtailed when electric supply exceeds overall electric demand[4], rooftop PV customers might find themselves paying for grid power that they had not budgeted for unless the CPUC provides for a mechanism that compensates building owners for involuntary production curtailments, which has problems of its own[5].

ZNE's On-Site Energy Requirement and Grid Reliability

Although ZNE requires an on-site *renewable* energy resource, the only practical method of meeting this requirement is through the use of solar PV. By increasing California's already heavy reliance on PV to meet the RPS requirements, the ZNE requirement for on-site generation is likely to have an adverse impact on grid reliability.

Studies by the California ISO suggest California will face an increasingly severe problem with excess supply during certain seasons and certain times of the day arising largely form the fact that a seasonal increase in PV production over the spring months will not be matched by increases in seasonal cooling load.

There are a number of ways to mitigate the problem, but all of these methods face political, economic, public acceptance and operational obstacles. As I pointed out earlier, storage is expensive, and building the amounts that would be needed to absorb even half of the projected surplus would cost tens of billions of dollars. Enlisting the cooperation of neighboring Balancing Authorities will help to some degree, but it will also require either selling the surplus at well below its levelized cost of production or paying neighboring utilities to take the energy. Both of these solutions mean California customers will end up paying twice for the same resource. In addition, increased cooperation among Balancing will require changes in operating practices that take a long time and a great deal of effort to define and implement. Curtailment faces contractual and economic obstacles, some of which I outlined above. Encouraging and engaging consumers to shift electricity use in ways that benefit the grid faces sizable obstacles in the form of consumer education and acceptance, rate design and the ability to deploy and coordinate automated devices.

Conclusion

Elements of the ZNE initiative that are focused on cost-effective energy efficiency measures are worth pursuing, and pursuing vigorously. However in spite of its intuitive and emotional appeal, the on-site generation requirement faces a number of practical, economic and political implementation challenges. Building owners who wish to install on-site generation should be encouraged to do so. However

[4] So-called overgeneration conditions exist when the combination of must-run nuclear, hydro, thermal and renewable generation exceeds electric demand.

[5] One way to handle this is to pass through wholesale prices, in which case the negative prices that are expected to accompany overgeneration conditions would pay consumers to use electricity.

requiring on-site generation is likely to prove expensive and to encounter significant consumer resistance. For these reasons, the requirement for on-site generation should be reconsidered.