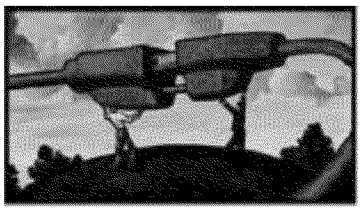

CALIFORNIA Energy Circuit
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GUEST JUICE: Evening Out Renewables

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By Edward Cazalet

To achieve our 33 percent renewable energy goals in 2020 we must now start building new electricity storage to support the alternative power supplies.

If we start now, we also may be able to attract federal stimulus funds. Waiting will mean we could lose federal matching funds and have to ramp up storage manufacturing even faster as we approach 2020.

By 2020, the peak load in California will be about 70 GW. The average load will be about 38 GW, and the minimum load will be less than 25 GW. To meet the 33 percent target, we will require about 25 GW (25,000 MW) of variable solar and wind generation.

(Current law requires utilities to provide 20 percent of their electricity generation "portfolio" from renewable resources by 2010--the rest can be fossil-fuel fired electricity. Legislation increasing that portfolio amount to 33 percent renewable energy by 2020 is expected to be pass and be signed by the governor the next few months.)

This 25 GW of uneven solar and wind generation will be a very large fraction of California's generation in 2020, which presents a number of serious challenges.

Matching variable generation to variable load is difficult. The only two economical, large-scale ways to provide reliable power from variable renewables are by using either fossil fuel generation or storage to compensate for the variability of the alternative energy resources. Demand response also can help.

Already the California Independent System Operator is putting stress on existing fossil generation by ramping it up and down as the needs on the grid change. Ramping fossil generation up and down not only wears out the generators, but it reduces efficiency and increases carbon dioxide and nitrogen oxide emissions. Today, we have about one-third of the wind and solar on the grid that we will have in 2020, so the requirements for more fossil plants--or storage--to handle the variability of renewable energy will increase substantially.

In our urban centers, such as San Francisco, Los Angeles, and San Diego, it is now next to impossible to site new fossil generation and obtain necessary air permits, so building new fossil plants there is not practical.

A further challenge is that we are losing the fossil plants that have historically provided adjustments to balance unpredictable renewable energy production. Along our coast, about 20 GW of oncethough- cooling generation is at risk because they must install expensive new dry cooling to continue operation to reduce their impacts to the aquatic environment. Renewable energy has and will displace the annual operating hours of these facilities, making these mandated dry-cooling upgrades uneconomical. As a result, many of the existing once-through cooling generators are expected to shut down rather than upgrade.

Construction of major new transmission lines into urban areas encounters opposition and can take many years. This creates a challenge in providing adequate transmission capacity to deliver remote renewable energy into load centers during periods of peak demand.

As a result of these and other constraints, the CAISO, California Energy Commission, California Public Utilities Commission, and most of the California utilities agree that storage is essential to meeting our 33 percent renewable energy goal.

Fortunately, there are several, commercial, grid-scale battery options. Japan has hundreds of megawatts of grid-scale sulfur sodium batteries on its power lines. Some have operated for over a decade. Such batteries are highly reliable and have a 15-year life. The technology is also being deployed at scale in the Middle East and has been demonstrated at scale on the distribution grid in this country by American Electric Power. Lithium-ion and lead acid batteries also have been deployed at multi-MW scales in the U.S.

In a number of public forums, I have advocated the deployment by 2020 of at least 4 GW (4,000 MW) of new grid-scale storage on the distribution grids in California. This concept has received wide support. Grid-scale battery storage can be deployed now and can be located close to the load. Battery storage has no air, water, or noise emissions. Four GW of distributed storage will provide 8 GW of dispatchability (4 GW charge rate plus 4 GW discharge rate) to integrate variable wind and solar. Batteries can respond almost instantly over their full range of dispatchability.

Four GW of distributed storage can also absorb 4 GW of nighttime over-generation from wind and other sources, bringing it to the load centers at night on existing transmission, and then delivering it during the day when we need it. Also, the same 4 GW of distributed storage can smooth photovoltaic generation during the day as clouds pass over distributed PV and the generation drops off rapidly. Four GW of distributed storage will avoid the need to construct up to 4 GW of transmission into load centers and can avoid the need for up to 4 GW of distribution investments.

Distributed storage is the only practical, large-scale and clean option for integrating a 33 percent variable renewable energy portfolio. Fast, clean and deep storage will be a lower cost alternative for providing 8 GW of fast dispatchability than fossil alternatives. Since fossil is not clean and cannot be installed in our urban areas where the need is, comparisons to fossil costs are unnecessary.

California's progress towards development of storage is stalled by complexities of CAISO dispatch, utility procurement, and a Federal Energy Regulatory Commission policy that does not allow paying for the transmission benefits of storage through transmission tariffs while dispatching it to balance variable wind and solar generation.

Storage is very different than fossil generation, just as renewables and demand response are different. We have moved forward on both renewables and demand response by establishing a 33 percent energy standard for renewables and a 5 percent of peak demand standard for demand response. We need to do the same for storage.

For these reasons, I advocate a standard of 5 percent of peak demand for fast, clean, deep and distributed new storage by 2020. This would provide about 4 GW of storage and this amount is a modest fraction of the variable renewables that will be in place in 2020. One GW might be installed in the San Francisco area, 2 GW in the Los Angeles area, and 1 GW in the San Diego area. Starting in about 2011, we would need to install about 500 MW per year of storage to support the 33 percent RPS goal for 2020.

At this battery demand level, manufacturers would locate battery manufacturing facilities in California and create jobs. Setting the storage goal at this level would create competition among manufacturers to lower costs and encourage new technology development.

It is now up to California's Public Utilities Commission, Energy Commission, and Independent System Operator, and perhaps the Legislature, to establish a portfolio standard for storage to

complement the standards they have set for renewables and demand response.

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