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Hydrogen -- Buffer Storage for Wind and Solar Power

Additional submitted attachment is included below.

HYDROGEN – BUFFER STORAGE FOR RENEWABLE ENERGY

California is now committed to 100% renewable electricity by 2045. The renewable resources sufficiently abundant to completely replace fossil fuel are wind and solar. Renewable power would have to be sufficient to meet peak demand – roughly double average demand. But increasing wind and solar capacity by double the average demand would not be enough. What if the wind should be calm when demand peaked? Since wind-plus-solar variability can easily exceed two-to-one, even a further doubling might be insufficient. If at all possible, a far more cost-effective way to deal with the combined variability of supply and demand is by time-shifting with long-term energy storage. Although renewable portfolio mandates have been highly effective, they have reached the limit of what they can accomplish. To be successful, California must now pursue long-term energy storage.

But long-term energy storage has its own issues: The excess energy that could accumulate over a season could overwhelm any ordinary storage medium. Sufficient buffer storage could be provided by a market medium: something that could be generated by electricity, sold at market price, and repurchased, when needed, to generate electricity. Hydrogen can be generated by electrolysis of water, store energy indefinitely, and be converted back to electricity by fuel cells. Hydrogen could provide the buffer storage for wind and solar power; but, first, it would have to become a widely available market commodity.

The California Independent System Operator (ISO) now curtails wind or solar power when it exceeds grid demand. Current annual curtailment is substantial – over 400 million kilowatt hours. If this power could be used to replace methane hydrogen with electrolysis hydrogen, it would generate 9,000 tons of hydrogen and reduce carbon-dioxide emissions by 24,000 tons. This is definitely worth pursuing, if only to reduce greenhouse gas emissions; but using the excess power to make hydrogen could also accelerate the growth of wind and solar capacity; and could lead to making hydrogen a market commodity.

How? The California ISO could locate one or more large hydrogen producers who would agree to make a portion of their hydrogen by electrolysis. As an inducement, California would provide the on-site hydrolysis facility. Whenever wholesale price declined to a chosen value, the ISO would divert enough power to the hydrogen producers to keep the wholesale price from going lower. If the price at which power would be diverted to making hydrogen were set at $.02/kWh, the hydrogen would cost about $1.00/kg – comparable to natural gas hydrogen. Preventing wholesale price from going below that value would materially reduce investment risk – promoting the growth of wind and solar capacity. To facilitate this growth, grid connection would be open to independent wind or solar suppliers. Each would pay a connection charge – to cover the upgrade of transmission infrastructure required by the increased load – and a monthly infrastructure maintenance fee. As soon as wind-plus-solar capacity was sufficient, wholesale electricity would be offered to anyone for making hydrogen by electrolysis.

What would be accomplished by these measures? Wind and solar capacity would grow in response to market forces, rather than being forced by legislative mandate. The new wind and solar power would be displacing fossil fuel for industry and transportation – sectors that had previously been resistant to greenhouse gas reduction efforts. (It is worth noting that very little of the additional wind and solar power would displace fossil fuel for generating electricity. This is because most of the existing fossil power would be needed to buffer the shortfall of wind-plus-solar power until hydrogen buffering became available.) The increased use of electrolysis would help to promote on-site hydrogen production. And – most important – electricity cost would no longer be an obstacle to hydrogen production.

With on-site production, hydrogen would be cheaper than petroleum for the same energy. Cleaner as well as cheaper, hydrogen would be the fuel of choice for a wide range of vehicles. The tipping point would come when energy companies – realizing that hydrogen was destined to become the new petroleum – began investing seriously in wind and solar power, and in producing hydrogen on-site at gas stations and truck-stops. Another fifteen years might be needed for hydrogen to replace half the petroleum for transportation. But, by then, it would have become a commodity – available for buffering both the shortfall and the excess of wind and solar power. And California would be on the path, not just to 100% renewable electricity, but to a carbon-free economy.

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