The cost of CCS - Carbon Capture and Sequestration - Makes Coal Power Uneconomical.

In the previous article, #3c uses a coal generator to supply backup power to the 100% renewables microgrid system consisting of 150 homes. This would be a small generator of approximate size 150 times 5000 watts per house = 750 kW. Possibly a 1 MW sized coal plant would be a good size as a backup system. If the cost were $5/watt, then the cost of that backup system would be $25,000 per household. Because the capital cost of a coal plant is high, using it as a backup system does not make sense. That high a capital cost only makes sense if the coal plant were used as a base loaded generator. Interestingly, if the 1 MW coal plant were to run all the time, the solar and wind systems would not be needed and neither would the EV (electric vehicle) storage, except the battery storage can supply peaking power when the 1 MW generator cannot supply all the power demanded by the 150 homes, which would be rarely. Also, the EVs are going to be needed anyway to transition off the burning of oil and gasoline.

Ignoring the cost of coal fuel, the capital cost of the 1 MW base loaded coal would be a levelized annual cost of ($25000/home)(.06)(1.06^25)/(1.06^25-1) = $1956 per home. Then spreading that annual levelized cost over the energy consumed on average is 195600 cents/yr / 25000 kWh = 7.8 cents per kWh. Therefore, the base loaded coal plant supplying all the power is much lower in cost than the 100% wind-solar renewables system power cost, which was 28 cents/kWh.

But there is a problem with this design. The coal plant emits a lot of CO2. That CO2 will need to be captured and stuffed into the ground. Current estimates for CCS are about $100 per tonne (2204 lbs). A 1000 MW coal plant that is base loaded produces about 3 million lbs of CO2 per hour. However the CCS takes away 15% of the energy so that the 1000 MW coal plant is now 850 MW net electrical output. Considering that our coal plant is not 100% base loaded, but runs at an average power level of (150 homes)(25 MWh)/(8760 MWh) = 42.8% or 0.428 MW net electrical output, then our coal plant for the microgrid produces (0.428/850)(3e6) = 1511 lbs CO2 per hour on average or 0.6854 tonnes per hour.

The CCS cost is $68.54 per hour. On a cents per kWh basis the CCS adds 6854/(428 kWh) = 16 cents per kWh. Adding the CCS cost/kWh to the original coal plant investment cost/kWh we have coal costing 8+16 = 24 cents per kWh and that does not include the cost of coal fuel itself. Neither does it include the cost to pipe the CO2 to some remote injection point. The energy cost of CO2 captured coal is nearly as expensive as our 100% renewables microgrid system. The only advantage of coal is that the power source is more reliable than the 100% renewables system, and that is why we were looking at coal in the first place.

Is there a better source of 24/7 power?