Small Nuclear Power Provides Reliability Without Needing a New Transmission Grid.

In the previous article, #3d uses a nuclear generator to supply continuous power to the 100% renewables microgrid system consisting of 150 homes. This would be a small generator of approximate size 150 times 2000 watts per house = 300 kW that runs all the time. If the cost were $10/watt, then the cost of that backup system would be $20,000 per household. This provides a base load power source of sufficient energy to get past the cloudy calm days. Such a system would provide an annual energy of (300)(8760)/150 = 17000 kWh annually per home or more than 50% of the annual energy needed. I will assume the nuclear generator actually provided 15,000 kWh annually to each homeowner. The wind generator could be eliminated from the mix of power sources saving the homeowner $20,000 in the cost of the wind turbine. The centralized solar farm could supply peaking power during the daytime and make up for the extra energy annually to get the annual 25,000 kWh annually.

The annual cost of the nuclear plant per homeowner would be (20000)(.06)(1.06^30)/(1.06^30-1) = $1453 annually and produce 15000 kWh. The energy cost is 145300/15000 = 9.7 cents per kWh. Nuclear also has an O&M cost that is about 1.6 cents/kWh bringing the total to about 11.3 cents per kWh for a small nuclear plant that costs 10,000 $/kW.

The cost of the centralized solar farm is $25,000 for 5000 watts per home, and produces 10,000 kWh annually. Its annual cost is (25,000)(.06)(1.06^25)/(1.06^25-1) = $1957 and the energy cost is 195700/10000 = 19.6 cents per kWh. Combining the solar and small nuclear plant costs produces an overall energy cost of (11.3)(15000)/(25000) + (19.6)(10000)/(25000) = 14.6 cents per kWh which is our lowest cost option yet. Note that we still have the EVs (electric vehicles) but the demand put on them to supply night time loads has been eliminated, thus extending the life of the batteries and saving a lot of money in transportation costs.

What about nuclear waste? The latest designs of small nuclear plants plan on using lower grade fuel and even burn what we would normally think of as nuclear waste as the main fuel of these plants. Therefore we create a new market for existing nuclear waste, and instead of throwing it away, we burn it further, getting much more energy out of the existing nuclear fuel, up to 100 times more energy. One example of a small nuclear plant is the Toshiba 4S plant:
http://www.chugachelectric.com/pdfs/agenda/wsagenda_090308_1-4.pdf

There are several advantages of a small nuclear plant:

1) 24/7 reliable power nearly eliminates the need for transmission,
2) 24/7 hour base load operation makes wind power unnecessary,
3) the plant site is a small footprint,
4) the 4S plant is air cooled, not needing water,
5) the 4S plant is fueled once and runs for 30 years continuously,
6) solar and nuclear compliment each other in that nuclear provides base load and solar daytime peaking,
7) EVs have a continuous source of power by which to charge their batteries
8) the liquid sodium does not require a pressurized vessel,
9) there is enough fuel to power these reactors for hundreds of years using IFR technology.
10) once the fuel is spent, the entire reactor assembly is shipped back to the factory for refurbishing and another 30 year run,
11) the design is tamper proof eliminating the ability of terrorists to steal nuclear materials,
12) the design is operator error proof, i.e. the design is inherently meltdown proof.