(2) If the energy transmitted by a 100-kilovolt power line 50 kilometers long is used to refine aluminum, about how long will it take to produce an amount of aluminum equal to that in the cables—an hour, a day, a week, a month, or a year?

The resistivity of aluminum is a little greater than that of copper; I'll take it as 3×10^{-8} ohm-m. The number of atoms per unit volume is nearly the same in all solids, 10^{29} m^{-3}. It must cost something like 15 electron volts per atom to refine aluminum, allowing for some ohmic losses in the electrolysis. That amounts to 2.4×10^{11} J/m^3. Think of the power line as a two-conductor dc line and let A be the cross section of the conductor in m^2. The line contains 10^5 A cubic meters of aluminum and its resistance in ohms is $3\times10^{-3}/A$. Suppose 10 percent of the power is lost in the line—a loss much smaller or much larger in normal operation would not be reasonable. Then with 100 kV at the input the power delivered to the load at the far end is $3\times10^{11}A$ watts, which amounts to 3 MW per m^3 of aluminum. The time required is therefore $2.4\times10^{11}/3\times10^6$, that is, 8×10^4 s, nearly *one day*. Note that A is left undetermined. A different technical-economic argument could yield an estimate of A.