Hisui's New Power Plant

To more accurately answer this objective, I had to split this challenge into two questions: 1) How much energy is needed by Jubilife Village? And 2) how much energy is produced by each Voltorb?

Towards the first, it seemed fairly straightforward. Using the comparative size of Jubilife village as the largest village in Sinnoh and one of largest in the entire Pokemon world, and compare that to a real life equivalent. As the Sinnoh region and the Pokemon world is based on the Hokkaido region and Japan, respectively, it would make sense that the closest real world equivalent of Jubilife is the city of Sapporo (largest city in Hokkaido and fifth largest city in Japan, by population; this maps to Jubilife, which is similarly the largest city in the Sinnoh region and the sixth largest in the Pokemon world). According to the Global Covenant of Mayors for Climate and Energy, Sapporo consumes 53002 TJ/year, for a per-capita energy consumption of 27.1 GJ/capita.

Herein presents another challenge, however, by the Anime's representation of Jubilife, this estimate seems reasonable. The images included in the wiki show the depiction of a traditional large city, and in the absence of much more information, our trail somewhat ends here, with our estimate of **Jubilife city's annual energy consumption at 53002 TJ/year, or daily consumption of 145.2 TJ/day.**

If, instead, we are to base our calculations on what most consider the source material – the game – those numbers seem dramatically inflated. The sizable discrepancy between the relative sizes of the cities in the Pokemon World to those may render the cumulative number invalid. We'd instead rely on the per capita measurements as the more reasonable estimate to be utilized in our calculations.

Of the 24 distinct buildings in the in-game city, only nine are accessible. Per Bulbapedia.bulbagarden.net, the most recent game depiction of Jubilife City has a population of 124 (while the previous game's depiction had a population of 87). This, multiplied by the per capita value, gives us an estimate of **Jubilife city's annual consumption at 3360.4 GJ/day, or a daily energy consumption of 9.21 GJ/day.**

The second component – estimating the electrical output of each individual Voltorb – was a bit trickier.

First and foremost, we operate under the assumption that there is a linear relationship between the amount of Voltorbs and the amount of electricity generated. That is to say, individual

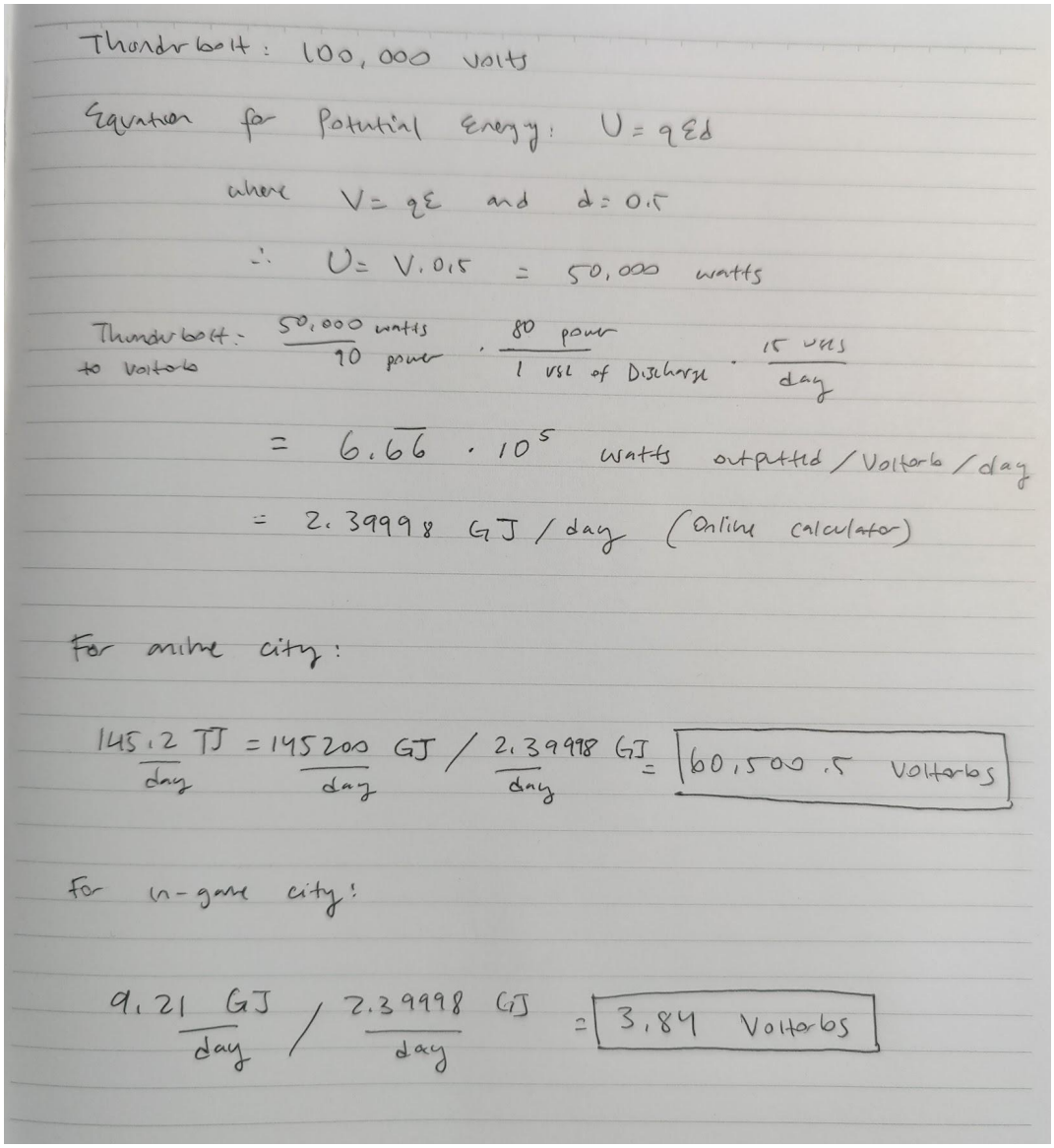
Voltorbs must be treated as individual “generators,” and thus two Voltorbs placed side by side would output the same amount of electricity as two Voltorbs placed in, say separate rooms. This linear relationship, and not an exponential or otherwise compounded effect, both makes intuitive sense and simplifies our calculations.

At this point, we can treat each Voltorb as a standard generator in the real world of comparable size, and proceed with our calculations as such. I thought it would be more interesting to take a deeper dive into the actual moveset of each Voltorb (which, presumably, is how the Voltorbs would be generating the electricity), however.

This would lead to a question of, “why Voltorb?” Presumably, there are more common Pokemon that we can catch that can still use these moves and produce electricity in this manner. As it’s presented in the problem, however, I won’t pursue this tangent.

Let’s consider Voltorb’s moveset, then. Voltorb can know four moves at a time. The more powerful moves, however, are learned using Technical Machine (TM), which are single-use and thus invalid (I’m operating under the assumption that we don’t have a stockpile of hundreds of Thunder TMs, for example, as they would be harder to stockpile than the Voltorbs themselves). The most relevant moves that Voltorb may know naturally are Discharge, Magnet Rise, Thunder Shock, Charge, Spark, and Electro Ball. And of these, Discharge seems to be the only moves that can freely summon and manipulate electricity, and thus our prime candidate.

Discharge is described as “a flare of electricity” per the in-game descriptions of each of these moves, and has a power of 80 and a power points rating (PP) 15 (ie. how many times the Pokemon can use each move). The only quantitative description we have of a move that I could find, however, was Thunderbolt (which releases 100,000 volts of electricity). But this, combined with some power/voltage scaling, reduces our calculations of the electrical output of each Voltorb to a matter of simple algebra and dimensional analysis (which I worked out on paper):



*note: we are making the assumption that the distance between the two charges (Voltorb and whatever is capturing its energy) is approximately 0.5 meter.

In conclusion, to power the city, as depicted in the anime (based on the real-world city of Sapporo, Japan), we would need about **60,500 Voltorbs**. And to power the much smaller city, as presented in the video games, we would only need about **4 Voltorbs**.