Given a typical charged parallel-plate capacitor (with equal but opposite charges on the plates that do not vary during this exercise), what happens to the energy stored in it if the plates are pulled back to twice their original separation? If the energy changes, where does the difference come from/go to?

Good analogy

Increasing the distance between plates does not affect the electric field between them. However, it does change their potential difference (ΔV). **If the plates have twice their original separation, ΔV will also have double the value since the two are proportional**.

$U = 1/2\ Q\ \Delta V$

$2U = Q\ \Delta V$

This is similar to if you raised an object double the distance from the ground. Their potential energy doubles because their ability to transfer energy is doubled in height.

You must pull charges opposite to the electric force on them

The potential difference across the plates is Ed, so, as you increase the plate separation, so does the potential difference across the plates increases and that is because only d is changing. **The energy stored in the capacitor increases and the energy is as a result of the work done in separating the plates**. The change in energy is by a factor of 2 since the distance d was doubled.

Confusing this with the thought experiment of separating charge

If the distance between the plates is doubled, the charge on each plate does not change but the stored energy would double. This is because doubling the distance in a uniform field would mean that **each charge would need twice the amount of energy to move from one plate to the other**.

Capacitance is measured in farads, which is defined so that a 1 farad capacitor has ±1 Coulomb of charge on its plates when a potential difference of 1 Volts exists between them. In practice, typical capacitors are about a centimeter square and have capacitances of a few microfarads. If you wanted a 1 farad capacitor, about how big would if have to be? Compare your answer to the size of some familiar, tangible object.

Formally correct but lacking details of calculation and comparison

If normal capacitors are a square cm and have a capacitance of about 3 microfarads, a capacitor that has a capacitance of 1 farad would have to be around 0.33e^6 cm^2

Simply scale the area

Capacitance depends on the geometry of the plates, the charged on the plates, electrical potential, and the distance in-between the plates. To get to microfarads to farads, **we need to increase the capacitance by a factor of 10^6.** **Therefore, each side of the plates is multiplied by a factor of 10^3.** Since capacitance is proportional to the area of the plates, the plates will be approximately 10 m^2, which is about the size of a typical one bedroom apartment.

Note: that should be read as (10 m)^2

Likewise:

The capacitance is has a relationship with the area of a plate. To get from microfarads to farads, the capacitance must increase by a factor of 10^6. **The area of a quadrilateral is found by a=bh, therefore each side of the capacitance must increase by a factor of 10^3 so that the total area will increase by a factor of 10^6.** Our large capacitors should be around 10 meters^2 to be measured in farads which would be the size of one of the Bruno great hall classrooms.

Just citing prior knowledge without reasoning isn't useful

With the technological innovation of supercapacitors, a 1 farad capacitor can be about 2 cm in diameter. They achieve this by creating a very long strip parallel plate capacitor and rolling it up into a cylinder. This is about the diameter of a penny.