LCL 10-9 The 10-ton golf cart

Could a golf cart store its energy in a capacitor?

a. To store this energy in a capacitor, we have an energy density $\frac{1}{2}\boldsymbol{D}\bullet\boldsymbol{E}$

(see "Energy In Dielectric"), but $\boldsymbol{D} = \varepsilon\boldsymbol{E}$,

so energy density is $\frac{1}{2}\varepsilon\boldsymbol{E}^2$, max. when $\boldsymbol{E}$ has max value a

b. For Mylar, $a = 1.6 \times 10^8$ volts/meter, $\varepsilon = 3.2\varepsilon_o \Rightarrow$

max energy density is $\frac{1}{2}\varepsilon\, a^2 = (1.6)^3 \times 10^{16} \times 8.9 \times 10^{-12}$ J

$$= 3.6 \times 10^5 \text{ J/m}^3$$

compare

1 kWh = 3600 kWsec = 3.6×10^6 Watt-sec = 3.6×10^6 J $\Rightarrow$

needed volume = 3.6×10^6 J/ 3.6×10^5 J/m^3 = 10 m^3 per kWh

estimate density of mylar similar to water $\approx$ 1 ton/m^3

$\Rightarrow$ 10 tons of capacitor needed

Note that an ordinary car battery, volume about 0.02 m^3, is rated at about 500 amperes at 12 volts for 30 seconds, about $500 \times 12 \times 30 = 1.8 \times 10^5$ J, for an energy density of about 1.8×10^5 J/0.02 m^3 = 9×10^6 J/m^3.
The battery offers an order of magnitude greater energy storage capacity, even by weight (batteries are much denser than mylar)