2.6 Electrostatic Energy (W_e)

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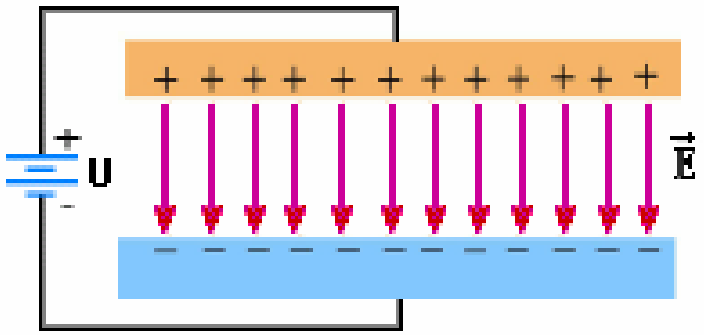
a) Energy In terms of Field quantities :



$$W_e = \frac{1}{2}\int_{V_\infty} \vec{E}.\vec{D}\,dV = \frac{1}{2}\int_{V_\infty} \varepsilon E^2.dV = \frac{1}{2}\int_{V_\infty} \frac{D^2}{\varepsilon}\,dV \qquad (J)$$

$$w_e = \frac{1}{2}\vec{E}\vec{D} = \frac{1}{2}\varepsilon E^2 = \frac{1}{2\varepsilon}D^2 \ (J/m^3)$$

= **Electrostatic energy density**

b) Energy In terms of Charge Distribution :

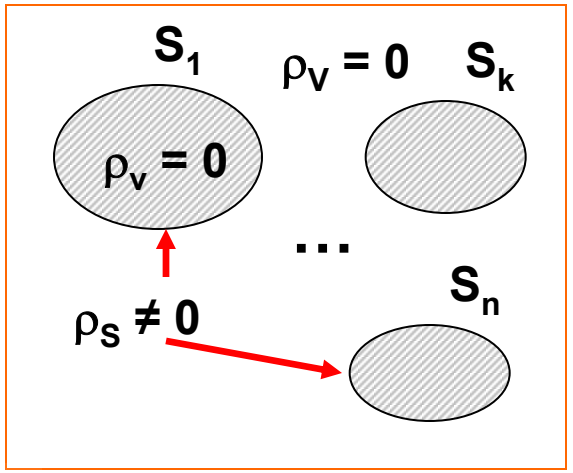
$$W_e = \frac{1}{2}\int_L \rho_\ell . \varphi . d\ell$$

$$W_e = \frac{1}{2}\int_S \rho_S . \varphi . dS$$

$$W_e = \frac{1}{2}\int_V \rho_V . \varphi . dV$$

c) Energy of N Conductors:

❖ **Cho hệ n vật dẫn trong miền $\rho_V = 0$: chỉ tồn tại ρ_S trên bề mặt các vật dẫn .**



$$W_e = \frac{1}{2}\int_V \rho_V \varphi dV + \frac{1}{2}\int_S \rho_S \varphi dS = \frac{1}{2}\int_S \rho_S \varphi dS$$

$$= \frac{1}{2}\sum_{k=1}^{n}\int_{S_k} \rho_S \varphi_k dS_k = \frac{1}{2}\sum_{k=1}^{n}\varphi_k \int_{S_k} \rho_S dS_k$$

$$= \frac{1}{2}\sum_{k=1}^{n}\varphi_k q_k \quad \Rightarrow \quad W_e = \frac{1}{2}\varphi_1 q_1 + \ldots + \frac{1}{2}\varphi_n q_n$$