

Conv. Utilizzatore

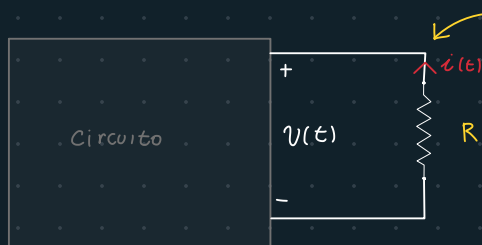
$$V(t) = R \cdot i(t)$$

$$P_a(t) = V(t) \cdot i(t)$$

$$P_a(t) = R i^2(t) \geq 0$$

Se  $R > 0$

Il resistore non ha mai potenza assorbita minore di zero!



generatore

$$V(t) = -R \cdot i(t)$$

ma  $P_e(t) = V(t) \cdot i(t) = -R i^2(t) \leq 0 \quad \forall i(t)$

Resistenza sempre  $> 0$

Inoltre so che

- $V(t) = R \cdot i(t) \Rightarrow i(t) = \frac{V(t)}{R} = \underset{\substack{\uparrow \\ \text{Conduttanza}}}{G} \cdot V(t) \Rightarrow P_a(t) = \underline{V^2(t) \cdot G} \geq 0$  Utilizzatore
- $V(t) = -R \cdot i(t) \Rightarrow i(t) = -\frac{V(t)}{R} = -G \cdot V(t) \Rightarrow P_e(t) = -V^2(t) \cdot G \leq 0$  generatore

Energia Assorbita

$$U_a(t, t_0) = \int_{t_0}^t P_a(\tau) d\tau$$

$$U_a(t, t_0) = \int_{t_0}^t R \cdot i^2(\tau) d\tau \geq 0 \quad \text{Energia Assorbita}$$

Corto circuito

$$R = 0 \Rightarrow \begin{cases} P_a(t) = 0 \\ P_e(t) = 0 \end{cases} \Rightarrow \begin{cases} U_a(t, t_0) = 0 \\ U_e(t, t_0) = 0 \end{cases}$$

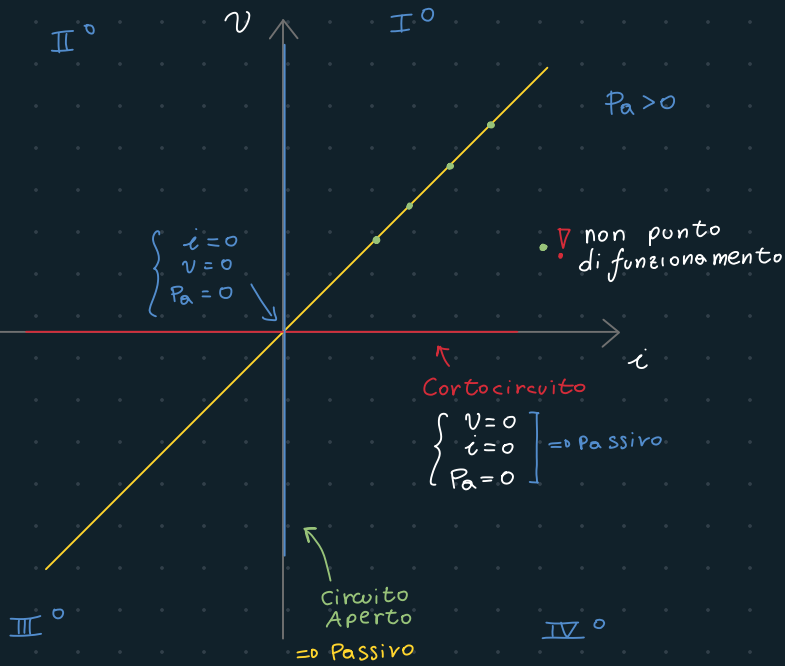
Circuito Aperto

$$G = 0 \Rightarrow \begin{cases} P_a(t) = 0 \\ P_e(t) = 0 \end{cases} \Rightarrow \begin{cases} U_a(t, t_0) = 0 \\ U_e(t, t_0) = 0 \end{cases}$$

$\downarrow$   
( $R \rightarrow +\infty$ )

Bipolo passivo

• Convenzione utilizzatore



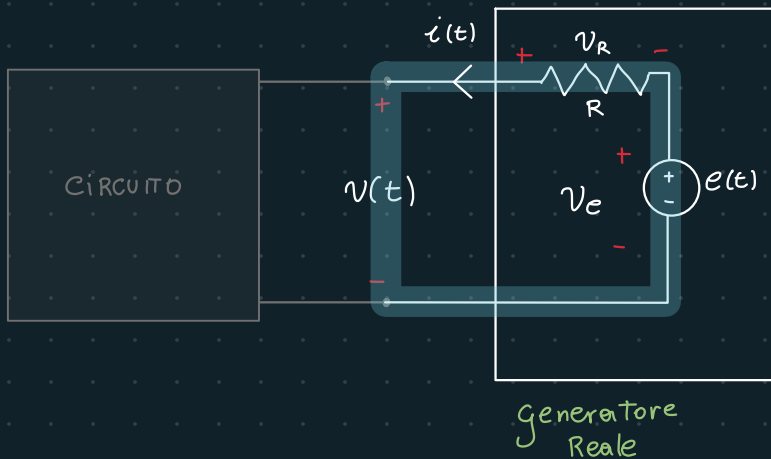
Senso ORARIO

$$\text{LKT: } -v(t) - v_R(t) + v_e(t) = 0$$

Equazioni Caratteristiche

$$v_R(t) = R \cdot i(t)$$

$$v_e(t) = i(t)$$



$$\begin{cases} -v(t) - v_R(t) + v_e(t) = 0 \\ v_R(t) = R \cdot i(t) \\ v_e(t) = i(t) \end{cases} \rightarrow \begin{cases} -v(t) - R \cdot i(t) + i(t) \\ \hookrightarrow v(t) = i(t) - R i(t) \end{cases}$$

Caratteristica del generatore Reale

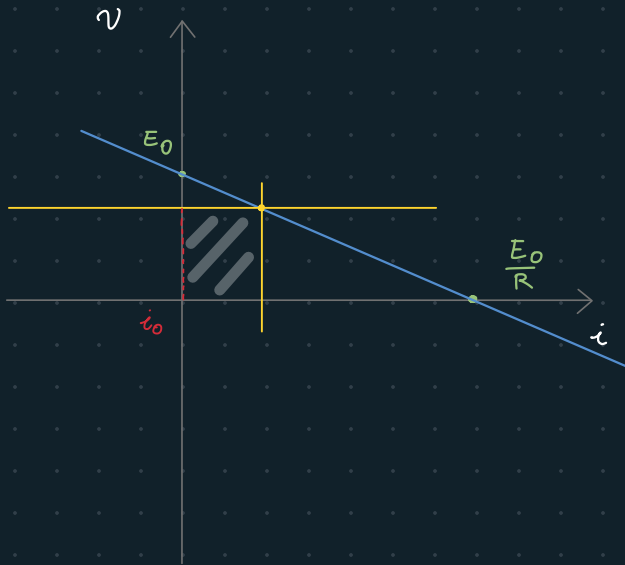
# Esempio di applicazione Batteria

H<sub>p</sub>: Se  $e(t) = \text{Cost} = E_0 > 0$  ->  $V = E_0 - R \cdot i$  RETTA

Esempio

Per Tracciarla ci bastano 2 punti!

Conv. generatore



=0  $\begin{cases} i=0 \rightarrow V=E_0 & \text{Tensione a vuoto} \\ V=0 \rightarrow i = \frac{E_0}{R} & \text{Corrente di cortocircuito} \end{cases}$

## ESEMPIO PRATICO

$E_0 = 1.4 \text{ V}$  }  $\frac{E_0}{R} = 140 \text{ A}$   
 $R = 10 \text{ m}\Omega$

## POTENZA MASSIMA

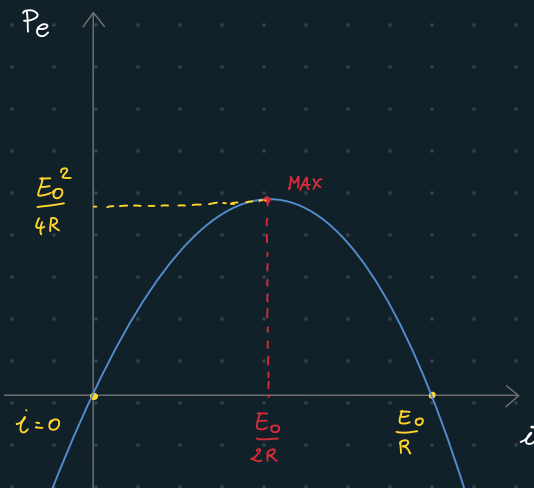
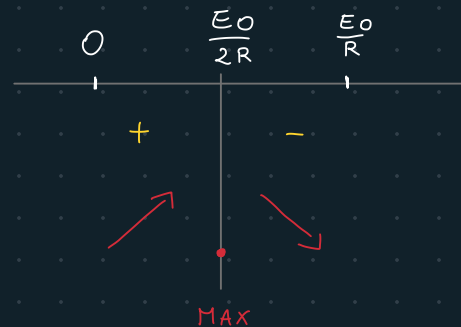
$P_e = V \cdot i = (E_0 - R i) i = E_0 i - R i^2$  PARABOLA

$\underbrace{E_0}_{\text{Costanti}} \cdot i = E_0 i$   $V = E_0 - R i$

$P_e'(i) = E_0 - 2 R i$

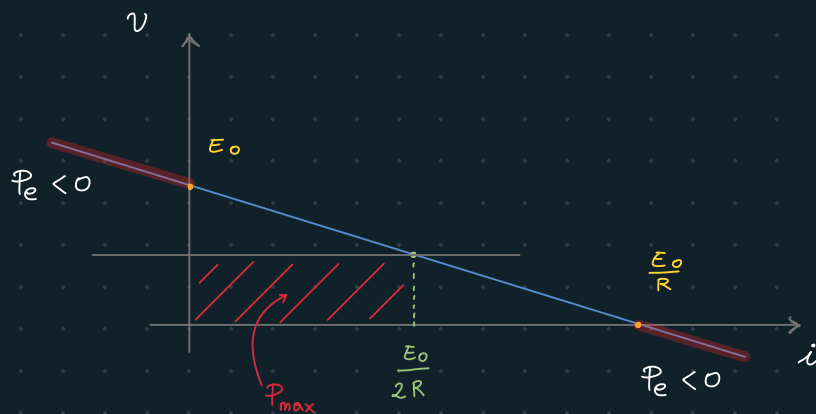
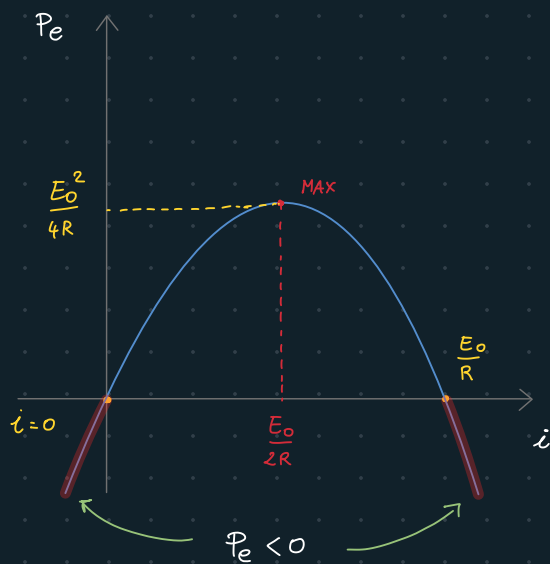
->  $P_e'(i) > 0 \rightarrow E_0 - 2 R i > 0$

per  $i < \frac{E_0}{2 R}$



$P_{\max} = P\left(\frac{E_0}{2R}\right) = E_0 \cdot \frac{E_0}{2R} - R \frac{E_0^2}{4R^2} = \frac{E_0^2}{2R} - \frac{E_0^2}{4R} = \frac{2E_0^2 - E_0^2}{4R} = \frac{E_0^2}{4R}$  Potenza Max

$i_{\max}$

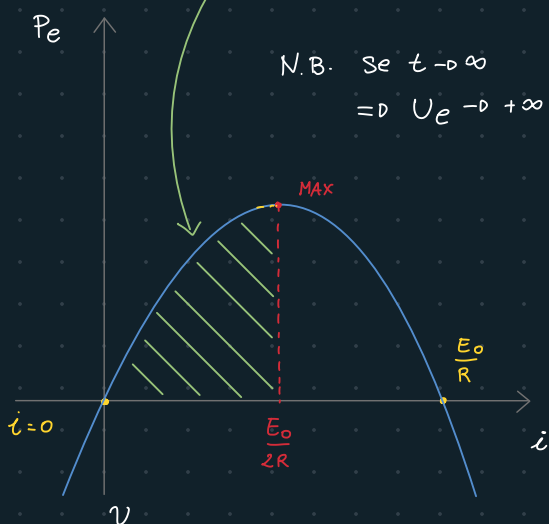


### Energia erogata

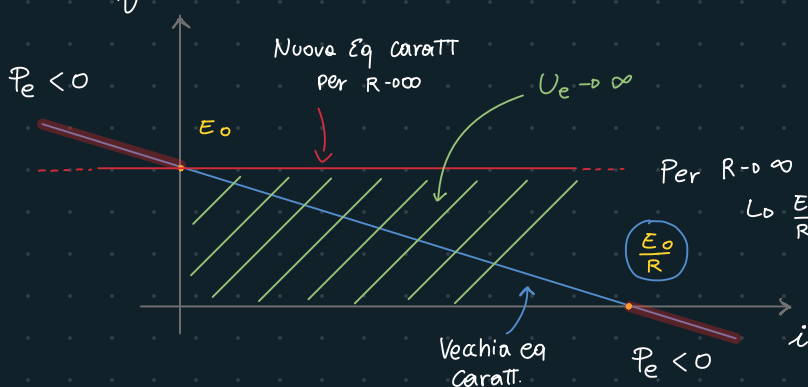
$$U_e(t, t_0) = \int_{t_0}^t P_e(\tau) d\tau \begin{matrix} > \\ < \end{matrix} 0$$

Dipende da  
Corrente e  
Tensione

Se  $\left\{ \begin{array}{l} e(t) = 0 \\ i(t) = \begin{cases} i_0 > 0 \\ i_0 < \frac{E_0}{2R} \end{cases} \end{array} \right\} \Rightarrow U_e > 0$



N.B. Se  $t \rightarrow \infty$   
 $\Rightarrow U_e \rightarrow +\infty$



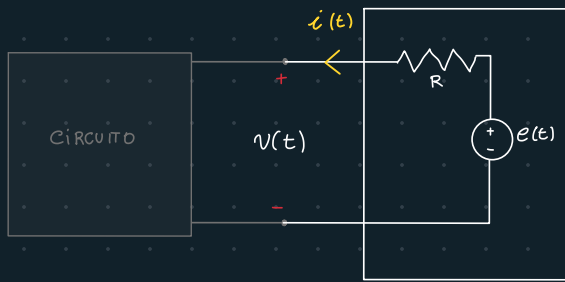
$$V_0 = E_0 \Rightarrow P_e = E_0 \cdot i \begin{matrix} > \\ < \end{matrix} 0$$

$$\text{Se } i_0 \rightarrow \infty \Rightarrow P_e \rightarrow \infty$$

$$\text{Per } R \rightarrow \infty \quad L_0 \frac{E_0}{R} \rightarrow \infty$$

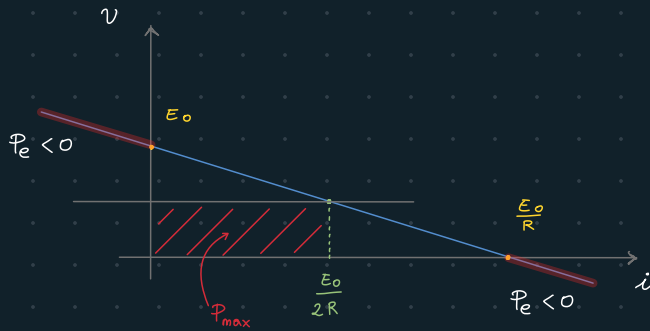
La retta Tende ad essere  
PARALLELA ad X

## Convenzione Generatore

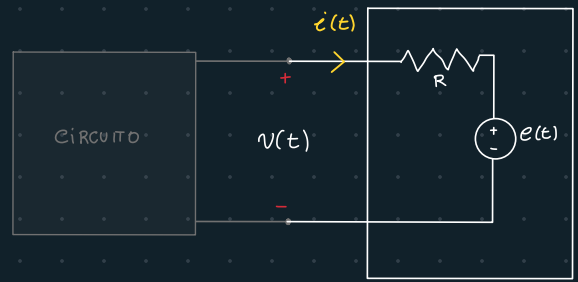


$$V(t) = e(t) - R i(t)$$

Generatore Reale

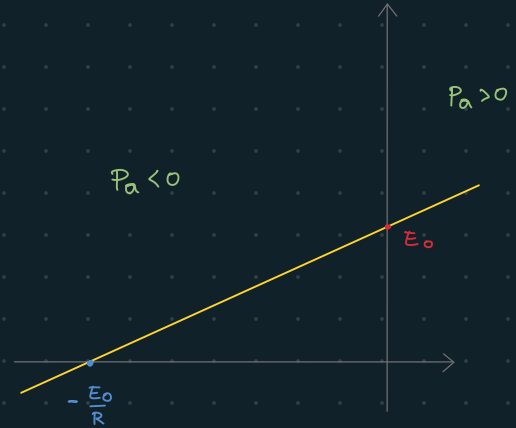


## Convenzione Utilizzatore

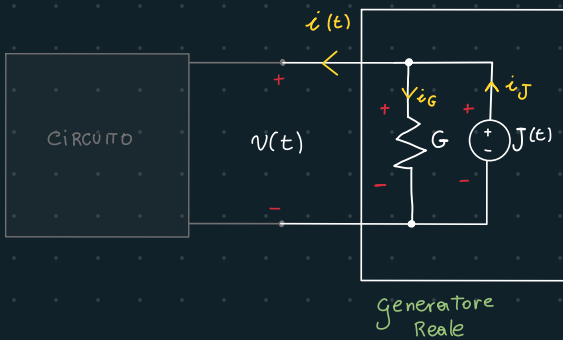


$$V(t) = e(t) + R i(t)$$

Generatore Reale



## Convenzione Generatore



Generatore Reale

$$LKC: i(t) + i_G(t) - i_J(t) = 0$$

LKT: Le Leggi di K. per le Tensioni  
ci riveleranno che le Tensioni sono  
Tutte uguali perché siamo in  
PARALLELO

## Relazioni caratteristiche, Utilizzatore

$$\begin{cases} i_G(t) = G \cdot V(t) & \text{Conduttanza} \\ i_J(t) = J(t) = I_0 & \text{#p: Cost} \end{cases}$$

Unisco

$$\begin{cases} LKT \\ LKC \\ R.C \end{cases} \rightarrow i(t) = I_0 - G \cdot V(t)$$

CARATTERISTICA  
Generatore corrente  
Reale

$$i(t) = I_0 - G \cdot V(t)$$

generatore

$$i(t) = I_0 + G \cdot V(t)$$

Utilizzatore

$P_{Max} \rightarrow$  limitata

Se  $G = 0 \Rightarrow P_{Max} \rightarrow \infty$

