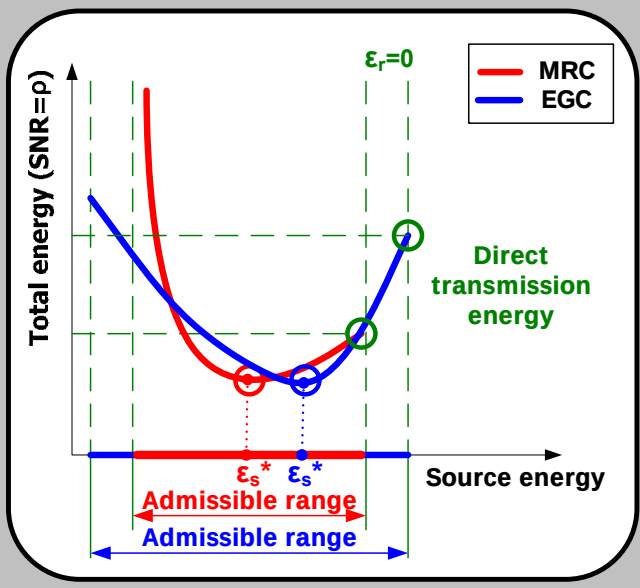
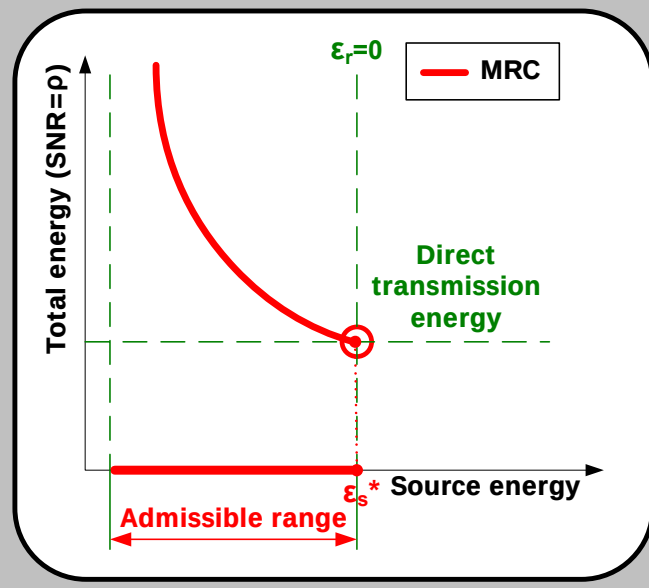
Optimum Energy Allocation Analysis

$$\{\mathcal{E}_s^*, \mathcal{E}_r^*\} = \arg \min_{\text{SNR}=\rho} (\mathcal{E}_s + \mathcal{E}_r)$$

- **What is the optimum energy allocation strategy ?**
- **When is cooperative transmission more energy efficient than direct transmission?**



Cooperative transmission is optimum



Direct transmission is optimum

Comparison between EGC and MRC

	EGC	MRC (from [2])
Admissible range of the source energy	$\mathcal{E}_s \in \left[\frac{2\rho}{2H+G_s}, \frac{2\rho}{G_s}\right]$	$\mathcal{E}_s \in \left(\frac{\rho}{H+G_s}, \frac{\rho}{G_s}\right]$
When to cooperate	Cooperative transmission is optimum for all channel states.	When $\frac{G_r}{G_s} > 1 + \frac{G_s}{H\rho}$, cooperative transmission is optimum. When $\frac{G_r}{G_s} \leq 1 + \frac{G_s}{H\rho}$, direct transmission is optimum.
Optimum Resource Allocation	No analytical solution. Numerical results aided by **Proposition 1:** Total energy is a *convex function* of the source energy on the admissible range.	$\mathcal{E}_s^* = \frac{1}{H+G_s}\left(\rho + \sqrt{\frac{(\rho H)(G_s+(1+\rho)H)}{(H(G_r-G_s)+G_sG_r)}}\right)$