

$$\begin{array}{l}
 \mathbf{f} \text{ (objective function)} \\
 \text{Metabolism} \\
 \text{Ribosomes} \\
 \text{Chaperones}
 \end{array}
 \begin{array}{c}
 \begin{bmatrix} 0 \\ S \end{bmatrix} \\
 \begin{bmatrix} 1 \\ \mu\text{C_E} \\ \mu\text{CR_M} \\ \mu\text{CC_M} \end{bmatrix} \\
 \begin{bmatrix} 0 \\ \mu\text{C_R} \\ \mu\text{CR_R} \\ \mu\text{CC_R} \end{bmatrix} \\
 \begin{bmatrix} 0 \\ \mu\text{C_C} \\ \mu\text{CR_C} \\ \mu\text{CC_C} \end{bmatrix}
 \end{array}
 = \mathbf{Aeq} = \mathbf{beq} = -
 \begin{array}{c}
 \begin{bmatrix} \mu\text{C_G} & \mu\text{C_Xc} & \mu\text{C_Xm} & \text{C_mrna} \\ \mu\text{CR_G} \\ \mu\text{CC_G} \end{bmatrix} \\
 \begin{bmatrix} \text{C_PG} & \text{Xc} & \text{Xmetab} & \text{Xmrna} \end{bmatrix}
 \end{array}
 \begin{array}{c}
 \mathbf{x} \\
 \mathbf{x}
 \end{array}
 \begin{array}{c}
 \begin{bmatrix} \mathbf{nu} & \mathbf{E} & \mathbf{R} & \mathbf{C} \end{bmatrix} \\
 \begin{bmatrix} \text{C_PG} & \text{Xc} & \text{Xmetab} & \text{Xmrna} \end{bmatrix}
 \end{array}$$

$$\begin{array}{l}
 \text{Flux} \\
 \text{Flux} \\
 \mathbf{D} \text{ (densité cytosol)} \\
 \mathbf{M} \text{ (densité membrane)} \\
 \text{ATP maintenance}
 \end{array}
 \begin{array}{c}
 \begin{bmatrix} I \\ -I \end{bmatrix} \\
 \begin{bmatrix} -\text{Pm.keff} \\ -\text{Pm.keff} \end{bmatrix} \\
 \begin{bmatrix} \text{CD_M} \\ \text{CD_M} \end{bmatrix} \\
 \begin{bmatrix} \text{CD_R} \\ \text{CD_R} \end{bmatrix} \\
 \begin{bmatrix} \text{CD_C} \\ \text{CD_C} \end{bmatrix} \\
 \text{nu_ATP}=-1
 \end{array}
 = \mathbf{A} \leq \mathbf{b} =
 \begin{array}{c}
 \begin{bmatrix} \text{D_c} \\ \text{D_m} \\ -\text{atp_m} \end{bmatrix} \\
 \begin{bmatrix} \mu\text{CD_G} \\ \mu\text{CD_G} \end{bmatrix}
 \end{array}
 -
 \begin{array}{c}
 \begin{bmatrix} \text{C_PG} & \text{Xc} & \text{Xmetab} & \text{Xmrna} \end{bmatrix}
 \end{array}
 \begin{array}{c}
 \mathbf{x} \\
 \mathbf{x}
 \end{array}$$