

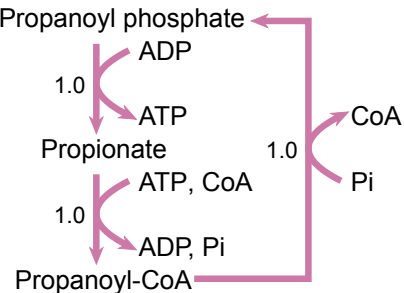
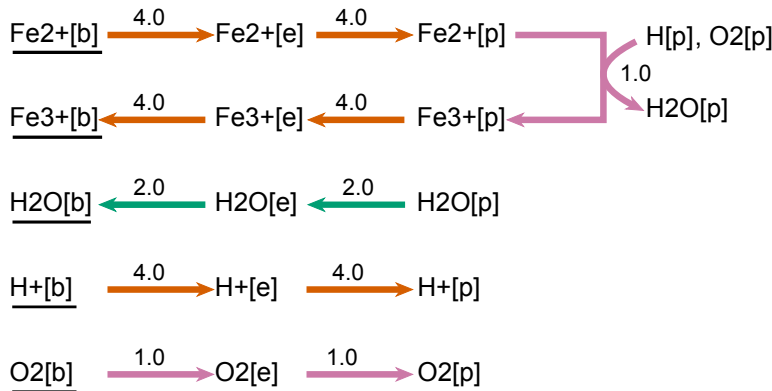
A**B**

Figure S1. Examples of rays in the *E.coli* iAF1260 genome-scale metabolic model.

Linealities and rays are typically cycles with no net conversion, but they can also represent uptake of boundary compound(s) which are then converted/transported and then excreted again. Boundary metabolites are fixed and are therefore not part of the stoichiometric matrix. For both types, we found examples in the *E. coli* iAF1260 genome-scale metabolic network which are shown in (A) and (B), respectively. For the ray shown in (B), the net conversion of boundary metabolites is $4 \text{ Fe}^{2+} + 4 \text{ H}^{+} + \text{O}_2 \rightarrow 4 \text{ Fe}^{3+} + 2 \text{ H}_2\text{O}$. These boundary metabolites are not part of the stoichiometric matrix, thus there is no net conversion in the model.