Table S1. Respiration reactions, rate expressions, and associated kinetic parameters added to the model. Reaction numbers are continued from the existing set of 179 model reactions [1].

#	Reaction stoichiometry and rate equation	Parameters	References
180[a]	$O_2 + 2\,Q_8H_2 \xrightarrow{Cyo} 2\,H_2O + 2\,Q_8$ $r = \dfrac{k_{cat}[\mathrm{Cyo}][O_2][Q_8H_2]^2}{K_{iq1}K_{mq2}[O_2] + K_{Q_8H_2}[Q_8H_2][O_2] + K_{O_2}[Q_8H_2]^2 + [Q_8H_2]^2[O_2]}$	k_{cat} = 18.3 to 150 s^{-1} $K_{iq1}K_{mq2} = 2.13 \times 10^{-10}$ M^2 $K_{Q8H2} = 5.3 \times 10^{-5}$ M $K_{O2} = 6.05 \times 10^{-6}$ M	[2-4] [5][d] [6] [2]
181	$O_2 + 2\,Q_8H_2 \xrightarrow{Cyd} 2\,H_2O + 2\,Q_8$ $r = \dfrac{k_{cat}[\mathrm{Cyd}][O_2][Q_8H_2]^2}{K_{iq1}K_{mq2}[O_2] + K_{Q_8H_2}[Q_8H_2][O_2] + K_{O_2}[Q_8H_2]^2 + [Q_8H_2]^2[O_2]}$	k_{cat} = 12 to 469 s^{-1} $K_{iq1}K_{mq2} = 2.13 \times 10^{-10}$ M^2 $K_{Q8H2} = 4.2 \times 10^{-5}$ M $K_{O2} = 2.7 \times 10^{-7}$ M	[2,4,5] [5] [5] [2]
182[b,c]	$\mathrm{NADH} + Q_8 + H^+ \xrightarrow{NDH-1} \mathrm{NAD}^+ + Q_8H_2$ $r = \left(\dfrac{P_{2Fe2S}(holo) + P_{4Fe4S}(holo)}{P_{FeS,TOT}}\right)\left(\dfrac{k_{cat}[\mathrm{NDH1}][Q_8][\mathrm{NADH}]}{K_{NADH}K_{d,Q_8} + K_{NADH}[Q_8] + K_{m,Q_8}[\mathrm{NADH}] + [Q_8][\mathrm{NADH}]}\right)$ where: $P_{FeS,TOT} = P_{2Fe2S}(holo) + P_{4Fe4S}(holo) + P_{2Fe2S}(\mathrm{DNIC})_2 + P_{4Fe4S}(\mathrm{RRE})_2 + P_{2Fe2S}(apo) + P_{4Fe4S}(apo)$	k_{cat} = 50 to 600 s^{-1} $K_{NADH} = 7.2 \times 10^{-6}$ M $K_{d,Q8} = 3.0 \times 10^{-5}$ M $K_{m,Q8} = 3.0 \times 10^{-5}$ M	[7,8] [7] [9][e] [9]
183[c]	$\mathrm{NADH} + Q_8 + H^+ \xrightarrow{NDH-2} \mathrm{NAD}^+ + Q_8H_2$ $r = \left(\dfrac{k_{cat}[\mathrm{NDH2}][Q_8][\mathrm{NADH}]}{K_{NADH}K_{d,Q_8} + K_{NADH}[Q_8] + K_{m,Q_8}[\mathrm{NADH}] + [Q_8][\mathrm{NADH}]}\right)$	k_{cat} = 17.1 to 474 s^{-1} $K_{NADH} = 5.7 \times 10^{-5}$ M $K_{d,Q8} = 5.9 \times 10^{-6}$ M $K_{m,Q8} = 5.9 \times 10^{-6}$ M	[10,11][f] [10] [12][e] [12]

a. Cytochrome *bo* quinol oxidation was assumed to proceed via a mechanism involving a ternary complex, as is reported for cytochrome *bd* [5].

b. The rate of NDH-1 was scaled by the ratio of undamaged [Fe-S] clusters to total [Fe-S] clusters to account for potential NO•-mediated inhibition of NDH-1 activity through nitrosylation of its [Fe-S] clusters.

c. The NDH-1 and NDH-2 rate equations are modeled following a sequential mechanism [13].

d. The $K_{iq1}K_{mq2}$ value for cytochrome *bo* was assumed to be equal to that of cytochrome *bd*.

e. The $K_{d,Q8}$ values for NDH-1 and NDH-2 were assumed to be equal to that of their $K_{m,Q8}$ values.

f. The literature NDH-2 k_{cat} values were reported in units of μmol NADH/mg protein/min [10,11], and were converted to units of s^{-1} via multiplication by the molecular weight of NDH-2, reported as 47.359 kDa based on its nucleotide sequence [14].

References

1. Robinson JL, Brynildsen MP: **A Kinetic Platform to Determine the Fate of Nitric Oxide in *Escherichia coli***. *PloS Comput Biol* 2013, **9**:e1003049.
2. Mason MG, Shepherd M, Nicholls P, Dobbin PS, Dodsworth KS, Poole RK, Cooper CE: **Cytochrome bd confers nitric oxide resistance to *Escherichia coli***. *Nat Chem Biol* 2009, **5**:94-96.
3. Bolgiano B, Salmon I, Poole RK: **Reactions of the membrane-bound cytochrome bo terminal oxidase of *Escherichia coli* with carbon monoxide and oxygen**. *Biochim Biophys Acta* 1993, **1141**:95-104.
4. Rice CW, Hempfling WP: **Oxygen-limited continuous culture and respiratory energy conservation in *Escherichia coli***. *J Bacteriol* 1978, **134**:115-124.
5. Junemann S, Butterworth PJ, Wrigglesworth JM: **A suggested mechanism for the catalytic cycle of cytochrome bd terminal oxidase based on kinetic analysis**. *Biochemistry* 1995, **34**:14861-14867.
6. Yap LL, Lin MT, Ouyang H, Samoilova RI, Dikanov SA, Gennis RB: **The quinone-binding sites of the cytochrome bo3 ubiquinol oxidase from *Escherichia coli***. *Biochim Biophys Acta* 2010, **1797**:1924-1932.
7. Verkhovskaya ML, Belevich N, Euro L, Wikstrom M, Verkhovsky MI: **Real-time electron transfer in respiratory complex I**. *Proc Natl Acad Sci U S A* 2008, **105**:3763-3767.
8. Leif H, Sled VD, Ohnishi T, Weiss H, Friedrich T: **Isolation and characterization of the proton-translocating NADH: ubiquinone oxidoreductase from *Escherichia coli***. *Eur J Biochem* 1995, **230**:538-548.
9. David P, Baumann M, Wikstrom M, Finel M: **Interaction of purified NDH-1 from *Escherichia coli* with ubiquinone analogues**. *Biochim Biophys Acta* 2002, **1553**:268-278.
10. Jaworowski A, Campbell HD, Poulis MI, Young IG: **Genetic identification and purification of the respiratory NADH dehydrogenase of *Escherichia coli***. *Biochemistry* 1981, **20**:2041-2047.
11. Villegas JM, Volentini SI, Rintoul MR, Rapisarda VA: **Amphipathic C-terminal region of *Escherichia coli* NADH dehydrogenase-2 mediates membrane localization**. *Arch Biochem Biophys* 2011, **505**:155-159.
12. Bjorklof K, Zickermann V, Finel M: **Purification of the 45 kDa, membrane bound NADH dehydrogenase of *Escherichia coli* (NDH-2) and analysis of its interaction with ubiquinone analogues**. *FEBS Lett* 2000, **467**:105-110.
13. Peercy BE, Cox SJ, Shalel-Levanon S, San KY, Bennett G: **A kinetic model of oxygen regulation of cytochrome production in *Escherichia coli***. *J Theor Biol* 2006, **242**:547-563.
14. Keseler IM, Mackie A, Peralta-Gil M, Santos-Zavaleta A, Gama-Castro S, Bonavides-Martinez C, Fulcher C, Huerta AM, Kothari A, Krummenacker M, et al.: **EcoCyc: fusing model organism databases with systems biology**. *Nucleic Acids Res* 2013, **41**:D605-D612.