**Table S1.** Model Reactions.

| № | Name | Reactants | Kinetic law | Reference |
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| 1 | Acetate influx from lower module | → ACEex | $\frac{\text{A_in_down}}{(\text{V_L_i} * 1000.0)}$ | [2] |
| 2 | Acetate influx from upper module | → ACEex | $\frac{\text{A_in_up}}{(\text{V_L_i} * 1000.0)}$ | [2] |
| 3 | Acetate efflux to lower module | ACEex → | $\frac{\text{A_out_down}}{(\text{V_L_i} * 1000.0)}$ | [2] |
| 4 | Acetate efflux to upper module | ACEex → | $\frac{\text{A_out_up}}{(\text{V_L_i} * 1000.0)}$ | [2] |
| 5 | Acetate production | → ACEex | q_A_p_mM | [2] |
| 6 | Acetate consumption | ACEex → | q_A_c_mM | [2] |
| 7 | Oxygen influx from lower module | → Oex | $\frac{\text{O_in_down}}{(\text{V_L_i} * 1000.0)}$ | [2] |
| 8 | Oxygen influx from upper module | → Oex | $\frac{\text{O_in_up}}{(\text{V_L_i} * 1000.0)}$ | [2] |
| 9 | Oxygen efflux to lower module | Oex → | $\frac{\text{O_out_down}}{(\text{V_L_i} * 1000.0)}$ | [2] |
| 10 | Oxygen efflux to upper module | Oex → | $\frac{\text{O_out_up}}{(\text{V_L_i} * 1000.0)}$ | [2] |
| 11 | Transfer of oxygen from the gas phase into the liquid phase | → Oex | OTR | [2] |

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| 12 | Outflow of moles of oxygen | $y_O \rightarrow$ | $\frac{(gas_flow * y_O + OTR * V_L_i)}{n_g}$ | [2] |
| 13 | Inflow of moles of oxygen | $\rightarrow y_O$ | $\frac{gas_flow * y_O_down}{n_g}$ | [2] |
| 14 | Substrate influx from lower module | $\rightarrow$ GLCex | $\frac{S_in_down}{(V_L_i * 1000.0)}$ | [2] |
| 15 | Substrate influx from upper module | $\rightarrow$ GLCex | $\frac{S_in_up}{(V_L_i * 1000.0)}$ | [2] |
| 16 | Substrate efflux to lower module | GLCex $\rightarrow$ | $\frac{S_out_down}{(V_L_i * 1000.0)}$ | [2] |
| 17 | Substrate efflux to upper module | GLCex $\rightarrow$ | $\frac{S_out_up}{(V_L_i * 1000.0)}$ | [2] |
| 18 | Substrate feeding | $\rightarrow$ GLCex | $\frac{F_S_feed}{(V_L_i * 1000.0)} * \left(\frac{1000.0}{180.0}\right)$ | [2] |
| 19 | Biomass influx from lower module | $\rightarrow X$ | $\frac{X_in_down}{(V_L_i * 1000.0)}$ | [2] |
| 20 | Biomass influx from upper module | $\rightarrow X$ | $\frac{X_in_up}{(V_L_i * 1000.0)}$ | [2] |
| 21 | Biomass efflux to lower module | $X \rightarrow$ | $\frac{X_out_down}{(V_L_i * 1000.0)}$ | [2] |
| 22 | Biomass efflux to upper module | $X \rightarrow$ | $\frac{X_out_up}{(V_L_i * 1000.0)}$ | [2] |
| 23 | Biomass dilution | $X \rightarrow$ | $D_r * X$ | [1] |

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| 24 | Biomass production | $\rightarrow$ X | $\mathrm{mu} * X$ | [1] |
| 25 | dO | Oex $\rightarrow$ | $\mathrm{q_0} * X$ | [2] |
| 26 | gO | $\rightarrow$ O | g0 | [2] |
| 27 | gFADH2 | $\rightarrow$ FADH2 | vFADH2 | [2] |
| 28 | gNADH | $\rightarrow$ NADH | vNADH | [2] |
| 29 | OP_FADH2 | FADH2 + O $\rightarrow$ | $\frac{\mathrm{v0Pmax} * \mathrm{FADH2} * \mathrm{O}}{((\mathrm{KOPFADH2} + \mathrm{FADH2}) * (\mathrm{KOPO} + \mathrm{O}))}$ | – |
| 30 | OP_NADH | NADH + O $\rightarrow$ | $\frac{\mathrm{v0Pmax} * \mathrm{default_NADH} * \mathrm{O}}{((\mathrm{KOPNADH} + \mathrm{default_NADH}) * (\mathrm{KOPO} + \mathrm{O}))}$ | – |
| 31 | vBMAcCoA | AcCoA $\leftrightarrow$ | $\mathrm{kBMGLCAcCoA} * \mathrm{AcCoA}$ | [1] |
| 32 | vBME4P | E4P $\leftrightarrow$ | $\mathrm{kBMGLCE4P} * \mathrm{E4P}$ | [1] |
| 33 | vBMF6P | F6P $\leftrightarrow$ | $\mathrm{kBMGLCF6P} * \mathrm{F6P}$ | [1] |
| 34 | vBMFUM | FUM $\leftrightarrow$ | $\mathrm{kBMGLCFUM} * \mathrm{FUM}$ | [1] |
| 35 | vBMG6P | G6P $\leftrightarrow$ | $\mathrm{kBMGLCG6P} * \mathrm{G6P}$ | [1] |
| 36 | vBMGAP | GAP $\leftrightarrow$ | $\mathrm{kBMGLCGAP} * \mathrm{GAP}$ | [1] |
| 37 | vBMOAA | OAA $\leftrightarrow$ | $\mathrm{kBMGLCOAA} * \mathrm{OAA}$ | [1] |
| 38 | vBMPEP | PEP $\leftrightarrow$ | $\mathrm{kBMGLCPEP} * \mathrm{PEP}$ | [1] |
| 39 | vBMPYR | PYR $\leftrightarrow$ | $\mathrm{kBMGLCPYR} * \mathrm{PYR}$ | [1] |

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| 40 | vBMR5P | R5P ↔ | kBMGLCR5P ∗ R5P | [1] |
| 41 | vBMSUC | SUC ↔ | kBMGLCSUC ∗ SUC | [1] |
| 42 | vBMaKG | aKG ↔ | kBMGLCaKG ∗ aKG | [1] |
| 43 | vD6PG | sixPG ↔ | mu ∗ sixPG | [1] |
| 44 | vD6PGL | sixPGL ↔ | mu ∗ sixPGL | [1] |
| 45 | vDACEex | ACEex ↔ | $D_r$ ∗ ACEex | [1] |
| 46 | vDAcCoA | AcCoA ↔ | mu ∗ AcCoA | [1] |
| 47 | vDAcP | AcP ↔ | mu ∗ AcP | [1] |
| 48 | vDAceK | AceK ↔ | (mu + kdegr) ∗ AceK | [1] |
| 49 | vDAcs | Acs ↔ | (mu + kdegr) ∗ Acs | [1] |
| 50 | vDCS | Cs ↔ | (mu + kdegr) ∗ Cs | [1] |
| 51 | vDE4P | E4P ↔ | mu ∗ E4P | [1] |
| 52 | vDF6P | F6P ↔ | mu ∗ F6P | [1] |
| 53 | vDFBP | FBP ↔ | mu ∗ FBP | [1] |
| 54 | vDFUM | FUM ↔ | mu ∗ FUM | [1] |
| 55 | vDFba | Fba ↔ | (mu + kdegr) ∗ Fba | [1] |
| 56 | vDFbp | Fbp ↔ | (mu + kdegr) ∗ Fbp | [1] |

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| 57 | vDFum | Fum ↔ | (mu + kdegr) ∗ Fum | [1] |
| 58 | vDG6P | G6P ↔ | mu ∗ G6P | [1] |
| 59 | vDGAP | GAP ↔ | mu ∗ GAP | [1] |
| 60 | vDGAPDH | Gapdh ↔ | (mu + kdegr) ∗ Gapdh | [1] |
| 61 | vDGLC | GLC ↔ | mu ∗ GLC | [1] |
| 62 | vDGLCex | GLCex ↔ | $D_r$ ∗ GLCex | [1] |
| 63 | vDGLCfeed | GLCfeed ↔ | $D_r$ ∗ GLCfeed | [1] |
| 64 | vDGOX | GOX ↔ | mu ∗ GOX | [1] |
| 65 | vDGlk | Glk ↔ | (mu + kdegr) ∗ Glk | [1] |
| 66 | vDICDH | Icdh ↔ | (mu + kdegr) ∗ Icdh | [1] |
| 67 | vDICDHP | IcdhP ↔ | (mu + kdegr) ∗ IcdhP | [1] |
| 68 | vDICIT | ICIT ↔ | mu ∗ ICIT | [1] |
| 69 | vDIcl | Icl ↔ | (mu + kdegr) ∗ Icl | [1] |
| 70 | vDKDPG | KDPG ↔ | mu ∗ KDPG | [1] |
| 71 | vDMAL | MAL ↔ | mu ∗ MAL | [1] |
| 72 | vDMDH | Mdh ↔ | (mu + kdegr) ∗ Mdh | [1] |
| 73 | vDMS | Ms ↔ | (mu + kdegr) ∗ Ms | [1] |

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| 74 | vDMaeB | MaeB ↔ | (mu + kdegr) ∗ MaeB | [1] |
| 75 | vDOAA | OAA ↔ | mu ∗ OAA | [1] |
| 76 | vDPDH | Pdh ↔ | (mu + kdegr) ∗ Pdh | [1] |
| 77 | vDPEP | PEP ↔ | mu ∗ PEP | [1] |
| 78 | vDPYR | PYR ↔ | mu ∗ PYR | [1] |
| 79 | vDPck | Pck ↔ | (mu + kdegr) ∗ Pck | [1] |
| 80 | vDPfk | Pfk ↔ | (mu + kdegr) ∗ Pfk | [1] |
| 81 | vDPpc | Ppc ↔ | (mu + kdegr) ∗ Ppc | [1] |
| 82 | vDPps | Pps ↔ | (mu + kdegr) ∗ Pps | [1] |
| 83 | vDPyk | Pyk ↔ | (mu + kdegr) ∗ Pyk | [1] |
| 84 | vDR5P | R5P ↔ | mu ∗ R5P | [1] |
| 85 | vDRU5P | RU5P ↔ | mu ∗ RU5P | [1] |
| 86 | vDS7P | S7P ↔ | mu ∗ S7P | [1] |
| 87 | vDSDH | Sdh ↔ | (mu + kdegr) ∗ Sdh | [1] |
| 88 | vDSUC | SUC ↔ | mu ∗ SUC | [1] |
| 89 | vDX5P | X5P ↔ | mu ∗ X5P | [1] |
| 90 | vDaKG | aKG ↔ | mu ∗ aKG | [1] |

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| 91 | vDaKGDH | akgdh ↔ | $(\mathrm{mu} + \mathrm{kdegr}) * \mathrm{akgdh}$ | [1] |
| 92 | vDcAMP | cAMP ↔ | $\mathrm{mu} * \mathrm{cAMP}$ | [1] |
| 93 | vE6PGDH | sixPG ↔ RU5P | $\frac{\mathrm{v6Pgdhmax} * \mathrm{sixPG} * \mathrm{NADP}}{\left(\begin{array}{c}(\mathrm{sixPG} + \mathrm{K6Pgdh6PG}) * \\ \left(\begin{array}{c}\mathrm{NADP} + \mathrm{K6PgdhNADP} * \\ \left(1.0 + \frac{\mathrm{NADPH}}{\mathrm{K6PgdhNADPHinh}}\right) * \\ \left(1.0 + \frac{\mathrm{ATP}}{\mathrm{K6PgdhATPinh}}\right)\end{array}\right)\end{array}\right)}$ | [1] |
| 94 | vEAceKki | Icdh ↔ IcdhP | $\frac{\frac{\mathrm{AceK} * \mathrm{kAceKkicat} * \mathrm{Icdh}}{\mathrm{KAceKIcdh}} * \left(\frac{1.0 + \mathrm{Icdh}}{\mathrm{KAceKIcdh}}\right)^{\mathrm{nAceK}-1.0}}{\left(1.0 + \frac{\mathrm{Icdh}}{\mathrm{KAceKIcdh}}\right)^{\mathrm{nAceK}} + \mathrm{LAceK} * \left(1.0 + \frac{\mathrm{OAA}}{\mathrm{KAceKOAA}}\right)^{\mathrm{nA}}}$ | [1] |
| 95 | vEAceKph | IcdhP ↔ Icdh | $\frac{\frac{\mathrm{AceK} * \mathrm{kAceKphcat} * \mathrm{IcdhP}}{\mathrm{KAceKIcdhP}} * \left(1.0 + \frac{\mathrm{IcdhP}}{\mathrm{KAceKIcdhP}}\right)^{\mathrm{nAceKph}-1.0}}{\left(\begin{array}{c}1.0 + \frac{\mathrm{IcdhP}}{\mathrm{KAceKIcdhP}}^{\mathrm{nAceKph}} + \\ \frac{\mathrm{LAceKph}}{\left(1.0 + \frac{\mathrm{OAA}}{\mathrm{KAceKphOAA}}\right)^{\mathrm{nAceKph}}}\end{array}\right)}$ | [1] |
| 96 | vECS | AcCoA + OAA ↔ ICIT | $\frac{\mathrm{Cs} * \mathrm{kCscat} * \mathrm{OAA} * \mathrm{AcCoA}}{\left(\begin{array}{c}\left(1.0 + \frac{\mathrm{aKG}}{\mathrm{KCsaKG}}\right) * \mathrm{KCsOAAAcCoA} * \mathrm{KCsAcCoA} + \\ \mathrm{KCsAcCoA} * \mathrm{OAA} + \\ \left(1.0 + \frac{\mathrm{aKG}}{\mathrm{KCsaKG}}\right) * \mathrm{KCsOAA} * \mathrm{AcCoA} + \\ \mathrm{OAA} * \mathrm{AcCoA}\end{array}\right)}$ | [1] |
| 97 | vECya | ↔ cAMP | $\frac{\mathrm{vCyamax} * \mathrm{EIIAP}}{(\mathrm{EIIAP} + \mathrm{KCyaEIIAP})}$ | [1] |

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| 98 | vEEda | KDPG ↔ GAP + PYR | $\frac{\text{vEdamax} * \text{QEdapH} * \left(\text{KDPG} - \frac{\text{GAP} * \text{PYR}}{\text{KEdaeq}}\right)}{\left(\begin{array}{c}\text{KEdaKDPGm} + \text{KDPG} + \\ \text{KEdaKDPGm} * \left(\begin{array}{c}\frac{\text{PYR}}{\text{KEdaPYRm}} + \frac{\text{GAP}}{\text{KEdaGAPm}} \\ + \frac{\text{PYR} * \text{GAP}}{(\text{KEdaPYRm} * \text{KEdaGAPm})}\end{array}\right)\end{array}\right)}$ | [1] |
| 99 | vEEdd | sixPG ↔ KDPG | $\frac{\text{QEddpH} * \left(-(\frac{\text{KDPG}}{\text{KEddeq}}) + \text{sixPG}\right) * \text{vEddmax}}{\left(\text{KEdd6PGm} + \frac{\text{KDPG} * \text{KEdd6PGm}}{\text{KEddKDPGm}} + \text{sixPG}\right)}$ | [1] |
| 100 | vEFba | FBP ↔ GAP | $\frac{\text{Fba} * \text{kFbacat} * \left(\text{FBP} - \frac{\text{GAP}^{2.0}}{\text{KFbaeq}}\right)}{\left(\begin{array}{c}\text{KFbaFBP} + \text{FBP} + \frac{\text{KFbaGAP} * \text{GAP}}{(\text{KFbaeq} * \text{VFbablf})} + \\ \frac{\text{KFbaDHAP} * \text{GAP}}{(\text{KFbaeq} * \text{VFbablf})} + \frac{\text{FBP} * \text{GAP}}{\text{KFbaGAPinh}} + \\ \frac{\text{GAP}^{2.0}}{(\text{KFbaeq} * \text{VFbablf})}\end{array}\right)}$ | [1] |
| 101 | vEFbp | FBP ↔ F6P | $\frac{\frac{\text{Fbp} * \text{kFbpcat} * \text{FBP}}{\text{KFbpFBP}} * 1.0 + \frac{\text{FBP}}{\text{KFbpFBP}}^{\text{nFbp}-1.0}}{\left(1.0 + \frac{\text{FBP}}{\text{KFbpFBP}}^{\text{nFbp}} + \frac{\text{LFbp}}{1.0 + \frac{\text{PEP}}{\text{KFbpPEP}}^{\text{nFbp}}}\right)}$ | [1] |
| 102 | vEFum | FUM ↔ MAL | $\frac{\text{vFum1max} * \text{vFum2max} * \left(\text{FUM} - \frac{\text{MAL}}{\text{KFumeq}}\right)}{\left(\begin{array}{c}\text{KFumFUMm} * \text{vFum2max} + \text{vFum2max} * \text{FUM} + \\ \frac{\text{vFum1max} * \text{MAL}}{\text{KFumeq}}\end{array}\right)}$ | [1] |
| 103 | vEG6PDH | G6P ↔ sixPGL | $\frac{\text{vG6pdhmax} * \text{G6P} * \text{NADP}}{\left(\begin{array}{c}(\text{G6P} + \text{KG6pdhG6P}) * \\ \left(1.0 + \frac{\text{NADPH}}{\text{KG6pdhNADPHg6pinh}}\right) \\ * \left(\left(1.0 + \frac{\text{KG6pdhNADP} * \\ \text{NADPH}}{\text{KG6pdhNADPHnadpinh}}\right) + \text{NADP}\right)\end{array}\right)}$ | [1] |

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| 104 | vEGapdh | GAP ↔ PEP | $\frac{\text{Gapdh} * \text{kGapdhcat} * \left(\text{GAP} * \text{NAD} - \frac{\text{PEP} * \text{NADH}}{\text{KGapdheq}}\right)}{\left(\left(\text{KGapdhGAP} * \left(1.0 + \frac{\text{PEP}}{\text{KGapdhPGP}}\right) + \text{GAP}\right) * \left(\text{KGapdhNAD} * \left(1.0 + \frac{\text{NADH}}{\text{KGapdhNADH}}\right) + \text{NAD}\right)\right)}$ | [1] |
| 105 | vEGlk | GLC ↔ G6P | $\frac{\text{Glk} * \text{kGlkcat} * \left(\frac{\text{GLC}}{\text{KGlkGLCm}}\right) * \left(\frac{\text{ATP}}{\left(\text{KGlkATPm} * \left(1.0 + \frac{\text{G6P}}{\text{KGlkG6Pi}}\right)\right)}\right)}{\left(1.0 + \frac{\text{GLC}}{\text{KGlkGLCm}} + \frac{\text{ATP}}{\left(\text{KGlkATPm} * \left(1.0 + \frac{\text{G6P}}{\text{KGlkG6Pi}}\right)\right)} + \frac{\text{GLC} * \text{ATP}}{\left(\text{KGlkGLCm} * \text{KGlkATPm} * \left(1.0 + \frac{\text{G6P}}{\text{KGlkG6Pi}}\right)\right)} + \frac{\text{G6P}}{\text{KGlkG6Pi}}\right)}$ | [1] |
| 106 | vEICDH | ICIT ↔ aKG | $\frac{\frac{(\text{Icdh} + \text{icdhb}) * \text{kIcdhcat} * \text{ICIT}}{\text{KIcdhICIT}} * (1.0 + \frac{\text{ICIT}}{\text{KIcdhICIT}})^{\text{nIcdh}-1.0}}{\left(\left(1.0 + \frac{\text{ICIT}}{\text{KIcdhICIT}}\right)^{\text{nIcdh}} + \text{LIcdh} * (1.0 + \frac{\text{PEP}}{\text{KIcdhPEP}})^{\text{nIcdh}}\right)}$ | [1] |
| 107 | vEIcl | ICIT ↔ GOX + SUC | $\frac{\frac{\text{Icl} * \text{kIclcat} * \text{ICIT}}{\text{KIclICIT}} * (1.0 + \frac{\text{ICIT}}{\text{KIclICIT}})^{\text{nIcl}-1.0}}{\left((1.0 + \frac{\text{ICIT}}{\text{KIclICIT}})^{\text{nIcl}} + \text{LIcl} * (1.0 + \frac{\text{PEP}}{\text{KIclPEP}} + \frac{\text{GAP}}{\text{KIcl3PG}} + \frac{\text{aKG}}{\text{KIclaKG}})^{\text{nIcl}}\right)}$ | [1] |
| 108 | vEMS | AcCoA + GOX ↔ MAL | $\frac{\text{Ms} * \text{kMscat} * \text{GOX} * \text{AcCoA}}{\left(\text{KMsGOXAcCoA} * \text{KMsAcCoA} + \text{KMsAcCoA} * \text{GOX} + \text{KMsGOX} * \text{AcCoA} + \text{GOX} * \text{AcCoA}\right)}$ | [1] |

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| 109 | vEMaeB | MAL ↔ PYR | $\frac{\frac{\text{MaeB} * \text{kMaeBcat} * \text{MAL}}{\text{KMaeBMAL}} * (1.0 + \frac{\text{MAL}}{\text{KMaeBMAL}})^{\text{nMaeB}-1.0}}{\left((1.0 + \frac{\text{MAL}}{\text{KMaeBMAL}})^{\text{nMaeB}} + \text{LMaeB} * (1.0 + \frac{\text{AcCoA}}{\text{KMaeBAcCoA}} + \frac{\text{cAMP}}{\text{KMaeBcAMP}})^{\text{nMaeB}}\right)}$ | [1] |
| 110 | vEMdh | MAL ↔ OAA | $\frac{\text{vMdh1max} * \text{vMdh2max} * \left(\text{NAD} * \text{MAL} - \frac{\text{NADH} * \text{OAA}}{\text{KMdheq}}\right)}{\left(\begin{array}{c}\text{KMdhNADI} * \text{KMdhMALm} * \text{vMdh2max} + \\ \text{KMdhMALm} * \text{vMdh2max} * \text{NAD} + \\ \text{KMdhNADm} * \text{vMdh2max} * \text{MAL} + \\ \text{vMdh2max} * \text{NAD} * \text{MAL} + \\ \frac{\text{KMdhOAAm} * \text{vMdh1max} * \text{NADH}}{\text{KMdheq}} + \\ \frac{\text{KMdhNADHm} * \text{vMdh1max} * \text{OAA}}{\text{KMdheq}} + \\ \frac{\text{vMdh1max} * \text{NADH} * \text{OAA}}{\text{KMdheq}} + \\ \frac{\text{vMdh1max} * \text{KMdhOAAm} * \text{NAD} * \text{NADH}}{(\text{KMdheq} * \text{KMdhNADI})} + \\ \frac{\text{vMdh2max} * \text{KMdhNADm} * \text{MAL} * \text{OAA}}{\text{KMdhOAAI}} + \\ \frac{\text{vMdh2max} * \text{NAD} * \text{MAL} * \text{NADH}}{\text{KMdhNADHI}} + \\ \frac{\text{vMdh1max} * \text{MAL} * \text{NADH} * \text{OAA}}{(\text{KMdheq} * \text{KMdhMALI})} + \\ \frac{\text{vMdh2max} * \text{NAD} * \text{MAL} * \text{OAA}}{\text{KMdhOAAII}} + \\ \frac{\text{vMdh1max} * \text{NAD} * \text{NADH} * \text{OAA}}{(\text{KMdhNADII} * \text{KMdheq})} + \\ \left(\frac{\text{KMdhNADI} * \text{vMdh2max} * \text{NAD} * \text{MAL} * \text{NADH} * \text{OAA}}{(\text{KMdhNADII} * \text{KMdhOAAm} * \text{KMdhNADHI})}\right)\end{array}\right)}$ | [1] |
| 111 | vEPck | OAA ↔ PEP | $\frac{\frac{\text{Pck} * \text{kPckcat} * \text{OAA} * \text{ATP}}{\text{ADP}}}{\left(\begin{array}{c}\frac{\text{KPckOAA} * \text{ATP}}{\text{ADP}} + \frac{\text{OAA} * \text{ATP}}{\text{ADP}} + \\ \frac{\text{KPckATPi} * \text{KPckOAA}}{\text{KPckADPi}} + \\ \frac{\text{KPckATPi} * \text{KPckOAA}}{(\text{KPckPEP} * \text{KPckADPi})} * \text{PEP} + \\ \frac{\text{KPckATPi} * \text{KPckOAA}}{\frac{(\text{KPckPEPi} * \text{KPckATPI})}{\text{ADP}}} * \text{PEP} + \\ \frac{\text{KPckATPi} * \text{KPckOAA}}{(\text{KPckADPi} * \text{KPckOAAI})} * \text{OAA}\end{array}\right)}$ | [1] |

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| 112 | vEPdh | PYR ↔ AcCoA | $\frac{\mathrm{Pdh} * \mathrm{kPdhcat} * \left(\frac{1.0}{\left(1.0 + \frac{\mathrm{KPdhi} * \mathrm{NADH}}{\mathrm{NAD}}\right)}\right) * \left(\frac{\mathrm{PYR}}{\mathrm{KPdhPYRm}}\right) * \left(\frac{\mathrm{NAD}}{\mathrm{KPdhNADm}}\right) * \left(\frac{\mathrm{CoA}}{\mathrm{KPdhCoAm}}\right)}{\left(\begin{array}{c}\left(1.0 + \frac{\mathrm{PYR}}{\mathrm{KPdhPYRm}}\right) * \\ \left(1.0 + \frac{\mathrm{NAD}}{\mathrm{KPdhNADm}} + \frac{\mathrm{NADH}}{\mathrm{KPdhNADHm}}\right) * \\ \left(1.0 + \frac{\mathrm{CoA}}{\mathrm{KPdhCoAm}} + \frac{\mathrm{AcCoA}}{\mathrm{KPdhAcCoAm}}\right)\end{array}\right)}$ | [1] |
| 113 | vEPfk | F6P ↔ FBP | $\frac{\mathrm{Pfk} * \mathrm{kPfkcat} * \mathrm{ATP} * \mathrm{F6P}}{\left(\begin{array}{c}\left(\mathrm{ATP} + \mathrm{KPfkATPs} * \left(1.0 + \frac{\mathrm{ADP}}{\mathrm{KPfkADPc}}\right)\right) * \\ \left(\mathrm{F6P} + \frac{\mathrm{KPfkF6Ps} * A}{B}\right) * \\ \left(1.0 + \frac{\mathrm{LPfk}}{\left(1.0 + \frac{\mathrm{F6P} * B}{(\mathrm{KPfkF6Ps} * A)}\right)^{\mathrm{nPfk}}}\right)\end{array}\right)}$ | [1] |
| 114 | vEPgi | G6P ↔ F6P | $\frac{\mathrm{vPgimax} * \left(\mathrm{G6P} - \frac{\mathrm{F6P}}{\mathrm{KPgieq}}\right)}{\left(\left(\frac{1.0 + \mathrm{F6P}}{\left(\mathrm{KPgiF6P} * \left(1.0 + \frac{\mathrm{sixPG}}{\mathrm{KPgiF6P6pginh}}\right)\right) + \frac{\mathrm{sixPG}}{\mathrm{KPgiG6P6pginh}}}\right) * \mathrm{KPgiG6P} + \mathrm{G6P}\right)}$ | [1] |
| 115 | vEPgl | sixPGL ↔ sixPG | $\frac{\mathrm{vPglmax} * \left(\mathrm{sixPGL} - \frac{\mathrm{sixPG}}{\mathrm{KPgleq}}\right)}{\left(\begin{array}{c}\left(1.0 + \frac{H}{\mathrm{KPglh1}} + \frac{\mathrm{KPglh2}}{H}\right) * \\ \left(\mathrm{KPgl6PGLm} + \mathrm{sixPGL} + \frac{\mathrm{KPgl6PGLm}}{\mathrm{KPgl6PGm}} * \mathrm{sixPG}\right)\end{array}\right)}$ | [1] |
| 116 | vEPpc | PEP ↔ OAA | $\frac{\frac{\mathrm{Ppc} * \mathrm{kPpccat} * \mathrm{PEP}}{\mathrm{KPpcPEP}} * 1.0 + \frac{\mathrm{PEP}}{\mathrm{KPpcPEP}}^{\mathrm{nPpc}-1.0}}{\left(1.0 + \frac{\mathrm{PEP}}{\mathrm{KPpcPEP}}^{\mathrm{nPpc}} + \frac{\mathrm{LPpc}}{1.0 + \frac{\mathrm{FBP}}{\mathrm{KPpcFBP}}^{\mathrm{nPpc}}}\right)}$ | [1] |

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| 117 | vEPps | PYR ↔ PEP | $\frac{\frac{Pps * kPpscat * PYR}{KPpsPYR} * 1.0 + \frac{PYR}{KPpsPYR}^{nPps-1.0}}{\left(1.0 + \frac{PYR}{KPpsPYR}^{nPps} + LPps * 1.0 + \frac{PEP}{KPpsPEP}^{nPps}\right)}$ | [1] |
| 118 | vEPta | AcCoA ↔ AcP | $\frac{vPtamax * \left(\frac{1.0}{(KPtaAcCoAi * KPtaPim)}\right) * \left(AcCoA * Pi - \frac{AcP * CoA}{KPtaeq}\right)}{\left(\begin{array}{c}1.0 + \frac{AcCoA}{KPtaAcCoAi} + \frac{Pi}{KPtaPii} + \frac{AcP}{KPtaAcPi} + \\ \frac{CoA}{KPtaCoAi} + \frac{AcCoA * Pi}{(KPtaAcCoAi * KPtaPim)} + \\ \frac{AcP * CoA}{(KPtaAcPm * KPtaCoAi)}\end{array}\right)}$ | [1] |
| 119 | vEPyk | PEP ↔ PYR | $\frac{Pyk * kPykcat * PEP * \frac{PEP}{KPykPEP} + 1.0^{nPyk-1.0} * ADP}{\left(\begin{array}{c}KPykPEP * \\ \left(\begin{array}{c}LPyk * (\frac{\left(1.0 + \frac{ATP}{KPykATP}\right)}{\left(\frac{FBP}{KPykFBP} + \frac{AMP}{KPykAMP} + 1.0\right)})^{nPyk} + \\ (\frac{PEP}{KPykPEP} + 1.0)^{nPyk}\end{array}\right) * \\ (ADP + KPykADP)\end{array}\right)}$ | [1] |
| 120 | vER5PI | RU5P ↔ R5P | $vR5pimax * \left(RU5P - \frac{R5P}{KR5pieq}\right)$ | [1] |
| 121 | vERPE | RU5P ↔ X5P | $vRpemax * \left(RU5P - \frac{X5P}{KRpeeq}\right)$ | [1] |
| 122 | vESdh | SUC ↔ FUM | $\frac{vSdh1max * vSdh2max * \left(SUC - \frac{FUM}{KSdheq}\right)}{\left(\begin{array}{c}KSdhSUCm * vSdh2max + vSdh2max * SUC + \\ \frac{vSdh1max * FUM}{KSdheq}\end{array}\right)}$ | [1] |
| 123 | vETal | GAP + S7P ↔ E4P + F6P | $vTalmax * \left(GAP * S7P - \frac{E4P * F6P}{KTaleq}\right)$ | [1] |
| 124 | vETkt1 | R5P + X5P ↔ GAP + S7P | $vTkt1max * \left(R5P * X5P - \frac{S7P * GAP}{KTkt1eq}\right)$ | [1] |

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| 125 | vETkt2 | $\begin{matrix}E4P + X5P \leftrightarrow \\ F6P + GAP\end{matrix}$ | $vTkt2max * \left(X5P * E4P - \frac{F6P * GAP}{KTkt2eq}\right)$ | [1] |
| 126 | vEakgdh | $aKG \leftrightarrow SUC$ | $\frac{akgdh * kakgdhcat * aKG * CoA * NAD}{\left(\begin{matrix}KakgdhNADm * aKG * CoA + \\ KakgdhCoAm * aKG * NAD + \\ KakgdhaKGm * CoA * NAD + \\ aKG * CoA * NAD + \\ \frac{KakgdhaKGm * KakgdhZ * SUC * NADH}{KakgdhSUCI} + \\ \frac{KakgdhNADm * aKG * CoA * NADH}{KakgdhNADHI} + \\ \frac{KakgdhCoAm * aKG * NAD * SUC}{KakgdhSUCI} + \\ \frac{KakgdhaKGm * KakgdhZ * aKG * SUC * NADH}{(KakgdhaKGI * KakgdhSUCI)}\end{matrix}\right)}$ | [1] |
| 127 | vEcAMPdegr | $cAMP \leftrightarrow$ | $\frac{vcAMPdegrmax * cAMP}{(cAMP + KcAMPdegrcAMP)}$ | [1] |

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| 128 | vGaceA | ↔ Icl | $$\frac{mu * Kmu^{nmu}}{(mu^{nmu} + Kmu^{nmu})} * \left( \begin{array}{c} \left(1.0 - \frac{Cra}{(Cra + KaceBAKCra)}\right) * vaceBAKCraunbound + \\ \frac{Cra}{(Cra + KaceBAKCra)} * vaceBAKCrabound + \\ \left(1.0 - \frac{CrpcAMP}{(CrpcAMP + KaceBAKCrp)}\right) * vaceBAKCrpunbound + \\ \frac{CrpcAMP}{(CrpcAMP + KaceBAKCrp)} * vaceBAKCrpbound + \\ \left( \begin{array}{c} 1.0 - \frac{\frac{aceBAKDNA}{KaceBAKDNA} * \left(1.0 + \frac{PYR}{KaceBAKPYRprime}\right)}{\left(1.0 + \frac{1.0}{LaceBAK} * \left(\frac{GOX}{KaceBAKGOX}\right) * \left(1.0 + \frac{GOX}{KaceBAKGOX}\right) + \frac{aceBAKDNA}{KaceBAKDNA} + \frac{PYR}{KaceBAKPYR} + \frac{aceBAKDNA}{KaceBAKDNA} * \frac{PYR}{KaceBAKPYRprime}\right)} \end{array} \right) * \\ kaceBAKcatIclR * IclRtotal \end{array} \right)$$ | [1] |
| 129 | vGaceB | ↔ Ms | $$FactoraceB * \left(\frac{mu * Kmu^{nmu}}{(mu^{nmu} + Kmu^{nmu})}\right) *$$ | [1] |

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| | | | $\left( \begin{array}{c} \left(1.0 - \frac{\text{Cra}}{(\text{Cra} + \text{KaceBAKCra})}\right) * \\ \text{vaceBAKCraunbound} + \\ \frac{\text{Cra}}{(\text{Cra} + \text{KaceBAKCra})} * \text{vaceBAKCrabound} + \\ \left(1.0 - \frac{\text{CrpcAMP}}{(\text{CrpcAMP} + \text{KaceBAKCrp})}\right) * \\ \text{vaceBAKCrpunbound} + \\ \frac{\text{CrpcAMP}}{(\text{CrpcAMP} + \text{KaceBAKCrp})} * \text{vaceBAKCrpbound} + \\ \left( \begin{array}{c} 1.0 - \frac{\frac{\text{aceBAKDNA}}{\text{KaceBAKDNA}} * \left(1.0 + \frac{\text{PYR}}{\text{KaceBAKPYRprime}}\right)}{\left( \begin{array}{c} 1.0 + \frac{1.0}{\text{LaceBAK}} * \left(\frac{\text{GOX}}{\text{KaceBAKGOX}}\right) * \\ \left(1.0 + \frac{\text{GOX}}{\text{KaceBAKGOX}}\right) + \\ \frac{\text{aceBAKDNA}}{\text{KaceBAKDNA}} + \\ \frac{\text{PYR}}{\text{KaceBAKPYR}} + \frac{\text{aceBAKDNA}}{\text{KaceBAKDNA}} * \text{PYR} \\ \text{KaceBAKPYRprime} \end{array} \right)} \\ \text{kaceBAKcatIclR} * \text{IclRtotal} \end{array} \right) * \end{array} \right)$ | |
| 130 | vGaceK | $\leftrightarrow$ AceK | $\text{FactoraceK} * \left(\frac{\text{mu} * \text{Kmu}^{\text{nmu}}}{(\text{mu}^{\text{nmu}} + \text{Kmu}^{\text{nmu}})}\right) *$ | [1] |

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| | | | $\left(\begin{array}{c}\left(1.0-\frac{\text{Cra}}{(\text{Cra}+\text{KaceBAKCra})}\right)*\\ \text{vaceBAKCraunbound}+\\ \frac{\text{Cra}}{(\text{Cra}+\text{KaceBAKCra})}*\text{vaceBAKCrabound}+\\ \left(1.0-\frac{\text{CrpcAMP}}{(\text{CrpcAMP}+\text{KaceBAKCrp})}\right)*\\ \text{vaceBAKCrpunbound}+\\ \frac{\text{CrpcAMP}}{(\text{CrpcAMP}+\text{KaceBAKCrp})}*\text{vaceBAKCrpbound}+\\ \left(\begin{array}{c}\frac{\text{aceBAKDNA}}{\text{KaceBAKDNA}}*\\ \left(1.0+\frac{\text{PYR}}{\text{KaceBAKPYRprime}}\right)\\ 1.0-\frac{}{1.0+\frac{1.0}{\text{LaceBAK}}*\left(\frac{\text{GOX}}{\text{KaceBAKGOX}}\right)*}\\ \left(1.0+\frac{\text{GOX}}{\text{KaceBAKGOX}}\right)+\frac{\text{aceBAKDNA}}{\text{KaceBAKDNA}}\\ +\frac{\text{PYR}}{\text{KaceBAKPYR}}+\frac{\frac{\text{aceBAKDNA}}{\text{KaceBAKDNA}}*\text{PYR}}{\text{KaceBAKPYRprime}}\end{array}\right)\\ *\text{kaceBAKcatIclR}*\text{IclRtotal}\end{array}\right)$ | |
| 131 | vGacs | ↔ Acs | $\text{mu}*\left(\begin{array}{c}\left(1.0-\frac{\text{CrpcAMP}^{\text{nacs}}}{(\text{CrpcAMP}^{\text{nacs}}+\text{KacsCrp}^{\text{nacs}})}\right)*\\ \text{vacsCrpunbound}+\\ \frac{\text{CrpcAMP}^{\text{nacs}}}{(\text{CrpcAMP}^{\text{nacs}}+\text{KacsCrp}^{\text{nacs}})}*\\ \text{vacsCrpbound}\end{array}\right)$ | [1] |
| 132 | vGfbaA | ↔ Fba | $\text{mu}*\left(\begin{array}{c}\left(1.0-\frac{\text{Cra}}{(\text{Cra}+\text{KfbaACra})}\right)*\\ \text{vfbaACraunbound}+\\ \frac{\text{Cra}}{(\text{Cra}+\text{KfbaACra})}*\text{vfbaACrabound}+\\ \left(1.0-\frac{\text{CrpcAMP}}{(\text{CrpcAMP}+\text{KfbaACrp})}\right)*\\ \text{vfbaACrpunbound}\\ +\frac{\text{CrpcAMP}}{(\text{CrpcAMP}+\text{KfbaACrp})}*\text{vfbaACrpbound}\end{array}\right)$ | [1] |
| 133 | vGfbp | ↔ Fbp | $\text{mu}*\left(\left(1.0-\frac{\text{Cra}}{(\text{Cra}+\text{KfbpCra})}\right)*\text{vfbpCraunbound}+\frac{\text{Cra}}{(\text{Cra}+\text{KfbpCra})}*\text{vfbpCrabound}\right)$ | [1] |

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| 134 | vGfumABC | $\leftrightarrow$ Fum | $\text{mu} * \left( \begin{array}{c} \left( 1.0 - \frac{\text{CrpcAMP}^{\text{nfumABC}}}{\left( \text{CrpcAMP}^{\text{nfumABC}} + \text{KfumABCCrp}^{\text{nfumABC}} \right)} \right) * \\ \text{vfumABCCrpunbound} + \\ \frac{\text{CrpcAMP}^{\text{nfumABC}}}{(\text{CrpcAMP}^{\text{nfumABC}} + \text{KfumABCCrp}^{\text{nfumABC}})} * \\ \text{vfumABCCrpbound} \end{array} \right)$ | [1] |
| 135 | vGgapA | $\leftrightarrow$ GAP | $\text{mu} * \left( \begin{array}{c} \left( 1.0 - \frac{\text{Cra}}{(\text{Cra} + \text{KgapACra})} \right) * \\ \text{vgapACraunbound} + \\ \frac{\text{Cra}}{(\text{Cra} + \text{KgapACra})} * \text{vgapACrabound} + \\ \left( 1.0 - \frac{\text{CrpcAMP}}{(\text{CrpcAMP} + \text{KgapACrp})} \right) * \\ \text{vgapACrpunbound} + \\ \frac{\text{CrpcAMP}}{(\text{CrpcAMP} + \text{KgapACrp})} * \text{vgapACrpbound} \end{array} \right)$ | [1] |
| 136 | vGglk | $\leftrightarrow$ Glk | $\text{mu} * \left( \begin{array}{c} \left( 1.0 - \frac{\text{Cra}}{(\text{Cra} + \text{KglkCra})} \right) * \text{vglkCraunbound} + \\ \frac{\text{Cra}}{(\text{Cra} + \text{KglkCra})} * \text{vglkCrabound} \end{array} \right)$ | [1] |
| 137 | vGgltA | $\leftrightarrow$ Cs | $\text{mu} * \left( \begin{array}{c} \left( 1.0 - \frac{\text{CrpcAMP}^{\text{ngltA}}}{(\text{CrpcAMP}^{\text{ngltA}} + \text{KgltACrp}^{\text{ngltA}})} \right) * \\ \text{vgltACrpunbound} + \\ \frac{\text{CrpcAMP}^{\text{ngltA}}}{(\text{CrpcAMP}^{\text{ngltA}} + \text{KgltACrp}^{\text{ngltA}})} * \\ \text{vgltACrpbound} \end{array} \right)$ | [1] |
| 138 | vGicdA | $\leftrightarrow$ Icdh | $\text{mu} * \left( \begin{array}{c} \left( 1.0 - \frac{\text{Cra}}{(\text{Cra} + \text{KicdACra})} \right) * \\ \text{vicdACraunbound} + \\ \frac{\text{Cra}}{(\text{Cra} + \text{KicdACra})} * \text{vicdACrabound} \end{array} \right)$ | [1] |
| 139 | vGlpd | $\leftrightarrow$ Pdh | $\text{mu} * \left( \begin{array}{c} \left( 1.0 - \frac{\text{PdhR}}{(\text{PdhR} + \text{KlpdPdhR})} \right) * \\ \text{vlpdPdhRunbound} + \\ \frac{\text{PdhR}}{(\text{PdhR} + \text{KlpdPdhR})} * \text{vlpdPdhRbound} \end{array} \right)$ | [1] |

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| 140 | vGmaeB | $\leftrightarrow$ MaeB | $\text{mu} * \text{SSMaeB}$ | [1] |
| 141 | vGmdh | $\leftrightarrow$ Mdh | $\text{mu} * \left( \begin{array}{c} \left(1.0 - \frac{\text{CrpcAMP}}{(\text{CrpcAMP} + \text{KmdhCrp})}\right) * \\ \text{vmdhCrpunbound} \\ + \frac{\text{CrpcAMP}}{(\text{CrpcAMP} + \text{KmdhCrp})} * \text{vmdhCrpbound} \end{array} \right)$ | [1] |
| 142 | vGpckA | $\leftrightarrow$ Pck | $\text{mu} * \left( \begin{array}{c} \left(1.0 - \frac{\text{Cra}}{(\text{Cra} + \text{KpckACra})}\right) * \\ \text{vpckACraunbound} + \\ \frac{\text{Cra}}{(\text{Cra} + \text{KpckACra})} * \text{vpckACrabound} \end{array} \right)$ | [1] |
| 143 | vGpfkA | $\leftrightarrow$ Pfk | $\text{mu} * \left( \begin{array}{c} \left(1.0 - \frac{\text{Cra}}{(\text{Cra} + \text{KpfkACra})}\right) * \\ \text{vpfkACraunbound} + \\ \frac{\text{Cra}}{(\text{Cra} + \text{KpfkACra})} * \text{vpfkACrabound} \end{array} \right)$ | [1] |
| 144 | vGppc | $\leftrightarrow$ Ppc | $\text{mu} * \text{SSPpc}$ | [1] |
| 145 | vGppsA | $\leftrightarrow$ Pps | $\text{mu} * \left( \begin{array}{c} \left(1.0 - \frac{\text{Cra}}{(\text{Cra} + \text{KppsACra})}\right) * \\ \text{vppsACraunbound} + \\ \frac{\text{Cra}}{(\text{Cra} + \text{KppsACra})} * \text{vppsACrabound} \end{array} \right)$ | [1] |
| 146 | vGpykF | $\leftrightarrow$ Pyk | $\text{mu} * \left( \begin{array}{c} \left(1.0 - \frac{\text{Cra}}{(\text{Cra} + \text{KpykFCra})}\right) * \\ \text{vpykFCraunbound} + \\ \frac{\text{Cra}}{(\text{Cra} + \text{KpykFCra})} * \text{vpykFCrabound} \end{array} \right)$ | [1] |

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| 147 | vGsdhCDAB | $\leftrightarrow$ Sdh | $\mathrm{mu} * \left( \begin{array}{c} \left( 1.0 - \frac{\mathrm{CrpcAMP^{nsdhCDAB}}}{\left( \mathrm{CrpcAMP^{nsdhCDAB}} + \mathrm{KsdhCDABCrp^{nsdhCDAB}} \right)} \right) * \\ \mathrm{vsdhCDABCrpunbound} + \\ \frac{\mathrm{CrpcAMP^{nsdhCDAB}}}{\left( \mathrm{CrpcAMP^{nsdhCDAB}} + \mathrm{KsdhCDABCrp^{nsdhCDAB}} \right)} * \\ \mathrm{vsdhCDABCrpbound} \end{array} \right)$ | [1] |
| 148 | vGsucAB | $\leftrightarrow$ akgdh | $\mathrm{mu} * \left( \begin{array}{c} \left( 1.0 - \frac{\mathrm{CrpcAMP^{nsucAB}}}{\left( \mathrm{CrpcAMP^{nsucAB}} + \right)} \right) * \\ \mathrm{vsucABCrpunbound} + \\ \frac{\mathrm{CrpcAMP^{nsucAB}}}{(\mathrm{CrpcAMP^{nsucAB}} + \mathrm{KsucABCrp^{nsucAB}})} * \\ \mathrm{vsucABCrpbound} \end{array} \right)$ | [1] |
| 149 | vPTS1 | PEP $\leftrightarrow$ EIIAP + PYR | $(\mathrm{kPts1} * \mathrm{PEP} * \mathrm{EIIA} - \mathrm{kmPts1} * \mathrm{PYR} * \mathrm{EIIAP})$ | [1] |

**References**


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