

### Text S3 Rate equations

$$v_{glr} = \frac{V_{\max, glr} \cdot \left( \frac{Glc_o}{K_{m, glr, Glc}} - \frac{Glc_i(t)}{K_{m, glr, Glc} \cdot K_{eq, glr}} \right)}{1 + \frac{Glc_o}{K_{m, glr, Glc}} + \frac{Glc_i(t)}{K_{m, glr, Glc}} + P \cdot \frac{Glc_o \cdot Glc_i(t)}{K_{m, glr, Glc} \cdot K_{m, glr, Glc}}} \quad (13)$$

$$v_{hk} = \frac{V_{\max, hk} \cdot \left( \frac{Glc_i(t)}{K_{m, hk, Glc}} - \frac{ATP}{K_{m, hk, ATP}} - \frac{G6P(t) \cdot ADP}{K_{m, hk, Glc} \cdot K_{m, hk, ATP} \cdot K_{eq, hk}} \right)}{\left( 1 + \frac{Glc_i(t)}{K_{m, hk, Glc}} + \frac{G6P(t)}{K_{m, hk, G6P}} + \frac{T6P}{K_{i, hk, T6P}} \right) \cdot \left( 1 + \frac{ATP}{K_{m, hk, ATP}} + \frac{ADP}{K_{m, hk, ADP}} \right)} \quad (14)$$

$$v_{tre1} = K_{tre1} \quad (15)$$

$$v_{tre2} = K_{tre2} \quad (16)$$

$$v_{pgi} = \frac{V_{\max, pgi} \cdot \left( \frac{G6P(t)}{K_{m, pgi, G6P}} - \frac{F6P(t)}{K_{m, pgi, F6P} \cdot K_{eq, pgi}} \right)}{1 + \frac{G6P(t)}{K_{m, pgi, G6P}} + \frac{F6P(t)}{K_{m, pgi, F6P}}} \quad (17)$$

$$v_{pfr} = \frac{V_{\max, pfr} \cdot gR_{PFK} \cdot F6P(t) \cdot ATP \cdot \left( 1 + \frac{F6P(t) \cdot ATP}{K_{m, pfr, F6P} \cdot K_{m, pfr, ATP}} + \frac{gR_{PFK} \cdot F6P(t) \cdot ATP}{K_{m, pfr, F6P} \cdot K_{m, pfr, ATP}} \right)}{K_{m, pfr, F6P} \cdot K_{m, pfr, ATP} \cdot \left( \left( 1 + \frac{F6P(t) \cdot ATP}{K_{m, pfr, F6P} \cdot K_{m, pfr, ATP}} + \frac{gR_{PFK} \cdot F6P(t) \cdot ATP}{K_{m, pfr, F6P} \cdot K_{m, pfr, ATP}} \right)^2 + L_{PFK} \cdot \left( 1 + \frac{C_{pfr, ATP} \cdot ATP}{K_{m, pfr, ATP}} \right)^2 \right)} \quad (18)$$

$$L_{PFK} = L_{0, PFK} \cdot \left( \frac{1 + \frac{C_{i, pfr, ATP} \cdot ATP}{K_{pfr, ATP}}}{1 + \frac{ATP}{K_{pfr, ATP}}} \right)^2 \cdot \left( \frac{1 + \frac{C_{i, pfr, AMP} \cdot AMP}{K_{pfr, AMP}}}{1 + \frac{AMP}{K_{pfr, AMP}}} \right)^2 \cdot \left( \frac{1 + \frac{C_{i, pfr, F26BP} \cdot F26BP}{K_{pfr, F26BP}} + \frac{C_{i, pfr, F16BP} \cdot F16BP}{K_{pfr, F16BP}}}{1 + \frac{F26BP}{K_{pfr, F26BP}} + \frac{F16BP}{K_{pfr, F16BP}}} \right)^2$$

$$v_{ald} = \frac{V_{\max, ald} \cdot \left( \frac{K_{eq, TPI} \cdot TRIO(t)}{K_{m, ald, F16BP}} - \frac{TRIO(t)}{K_{m, ald, F16BP} \cdot K_{eq, ald}} \right)}{1 + \frac{F16BP(t)}{K_{m, ald, F16BP}} + \frac{K_{eq, TPI} \cdot TRIO(t)}{1 + K_{eq, TPI}} + \frac{TRIO(t)}{K_{m, ald, DHAP}} + \frac{K_{eq, TPI} \cdot TRIO(t)}{1 + K_{eq, TPI}} + \frac{TRIO(t)}{K_{m, ald, GAP} \cdot K_{m, ald, DHAP}} + \frac{F16P(t) \cdot K_{eq, TPI} \cdot TRIO(t)}{K_{i, ald, GAP} \cdot K_{m, ald, F16BP}}} \quad (19)$$

$$v_{gly} = K_{gly} \quad (20)$$

$$v_{gapdh} = \frac{V_{\max, gapdh}^+ \cdot \frac{K_{eq, TPI} \cdot TRIO(t)}{1 + K_{eq, TPI}} \cdot (NADt - NADH(t))}{K_{m, gapdh, GAP} \cdot K_{m, gapdh, NAD}} - \frac{V_{\max, gapdh}^- \cdot BPG(t) \cdot NADH(t)}{K_{m, gapdh, BPG} \cdot K_{m, gapdh, NADH}}}{\left( 1 + \frac{K_{eq, TPI} \cdot TRIO(t)}{1 + K_{eq, TPI}} + \frac{BPG(t)}{K_{m, gapdh, BPG}} \right) \cdot \left( 1 + \frac{NADt - NADH(t)}{K_{m, gapdh, NAD}} + \frac{NADH(t)}{K_{m, gapdh, NADH}} \right)} \quad (21)$$

$$v_{pgk} = \frac{V_{\max, pgk}^- \cdot \left( \frac{K_{eq, gpk} \cdot BPG(t) \cdot ADP}{K_{m, pgk, BPG} \cdot K_{m, pgk, ATP}} - \frac{P3G(t) \cdot ATP}{K_{m, pgk, P3G} \cdot K_{m, pgk, ATP}} \right)}{\left( 1 + \frac{BPG(t)}{K_{m, pgk, BPG}} + \frac{P3G(t)}{K_{m, pgk, P3G}} \right) \cdot \left( 1 + \frac{ATP}{K_{m, pgk, ATP}} + \frac{ADP}{K_{m, pgk, ADP}} \right)} \quad (22)$$

$$v_{gpm} = \frac{V_{\max, gpm} \cdot \left( \frac{P3G(t)}{K_{m, gpm, P3G}} - \frac{P2G(t)}{K_{m, gpm, P2G} \cdot K_{eq, gpm}} \right)}{1 + \frac{P3G(t)}{K_{m, gpm, P3G}} + \frac{P2G(t)}{K_{m, gpm, P2G}}} \quad (23)$$

$$v_{eno} = \frac{V_{\max, eno} \cdot \left( \frac{P2G(t)}{K_{m, eno, P2G}} - \frac{PEP(t)}{K_{m, eno, PEP} \cdot K_{eq, eno}} \right)}{1 + \frac{P2G(t)}{K_{m, eno, P2G}} + \frac{PEP(t)}{K_{m, eno, PEP}}} \quad (24)$$

$$v_{pyk} = \frac{V_{\max, pyk} \cdot \frac{PEP(t)}{K_{m, pyk, PEP}} \cdot \left( \frac{PEP(t)}{K_{m, pyk, PEP}} + 1 \right)^{n_{pyk} - 1}}{L_{0, pyk} \cdot \left( \frac{ATP}{K_{m, pyk, ATP}} + 1 \right)^{n_{pyk}} + \left( 1 + \frac{PEP(t)}{K_{m, pyk, PEP}} \right)^{n_{pyk}}} \cdot \frac{ADP}{ADP + K_{m, pyk, ADP}} \quad (25)$$

$$v_{pdc} = \frac{V_{\max, pdc} \cdot PYR(t)^{NH_{PDC}}}{K_{m, pdc, PYR} \cdot \left( 1 + \frac{PYR(t)^{NH_{PDC}}}{K_{m, pdc, PYR}^{NH_{PDC}}} \right)} \quad (26)$$

$$v_{adh} = \frac{V_{\max, adh} \cdot \left( \frac{(NADt - NADH(t)) \cdot ETOH}{K_{i, adh, NAD} \cdot K_{m, adh, ETOH}} - \frac{NADH(t) \cdot ACALD(t)}{K_{i, adh, NAD} \cdot K_{m, adh, ETOH} \cdot K_{eq, adh}} \right)}{1 + \frac{NADt - NADH(t)}{K_{i, adh, NAD}} + \frac{K_{m, adh, NAD} \cdot ETOH}{K_{i, adh, NAD} \cdot K_{m, adh, ETOH}} + \frac{K_{m, adh, NADH} \cdot ACALD(t)}{K_{i, adh, NAD} \cdot K_{m, adh, ACALD}} + \frac{NADH(t)}{K_{i, adh, NADH}} + \frac{(NADt - NADH(t)) \cdot ETOH}{K_{i, adh, NAD} \cdot K_{m, adh, ETOH}} + \frac{K_{m, adh, NADH} \cdot (NADt - NADH(t)) \cdot ACALD(t)}{K_{i, adh, NAD} \cdot K_{i, adh, NADH} \cdot K_{m, adh, ACALD}} + \frac{K_{m, adh, NAD} \cdot NADH(t) \cdot ETOH}{K_{i, adh, NAD} \cdot K_{i, adh, NADH} \cdot K_{m, adh, ETOH}} + \frac{NADH(t) \cdot ACALD(t)}{K_{i, adh, NADH} \cdot K_{m, adh, ACALD}} + \frac{(NADt - NADH(t)) \cdot ETOH \cdot ACALD(t)}{K_{i, adh, NAD} \cdot K_{m, adh, ETOH} \cdot K_{i, adh, ACALD}} + \frac{NADH(t) \cdot ETOH \cdot ACALD(t)}{K_{i, adh, ETOH} \cdot K_{i, adh, NADH} \cdot K_{m, adh, ACALD}}} \quad (27)$$

$$v_{suc} = K_{suc} \quad (28)$$

$$v_{ace} = K_{ace} \cdot ACALD(t) \quad (29)$$