Supplementary materials

The slope of Eq. 1 in the plot of $lnk$ vs $1/T$ is given by

$$\frac{d\ln k}{d\left(\frac{1}{T}\right)} = -\frac{E_0 T^2}{(T - T_0)^2}$$ (S1)

For Eq. 2,

$$\frac{d\ln k}{d\left(\frac{1}{T}\right)} = -\left(T + \frac{\Delta H^\dagger}{R}\right)$$ (S2)

From Eq. S1 and Eq. S2, we can obtain

$$\frac{E_0 T^2}{(T - T_0)^2} = T + \frac{\Delta H^\dagger}{R}$$ (S3)

Re-arranging Eq. S3 gives

$$\Delta H^\dagger = \frac{E_0 R T^2}{(T - T_0)^2} - RT$$ (3)

Derivation of $T_{inf}$ from Kavanau model

$$k = d e^{-\frac{E_0}{T - T_0}}$$ (1)

$$k' = \frac{dk}{dT} = d e^{-\frac{E_0}{T - T_0}} \frac{E_0}{(T - T_0)^2}$$

$$k'' = \frac{d^2k}{dT^2} = d e^{-\frac{E_0}{T - T_0}} \frac{E_0(2T - 2T_0 - E_0)}{(T - T_0)^4}$$

$T_{inf}$ is the temperature when $k'' = 0$, thus

$$2T_{inf} - 2T_0 - E_0 = 0$$

$$T_{inf} = T_0 + 0.5E_0$$ (7)
Figure S1 Comparison of estimated $T_{inf}$ between the Kavanau model and MMRT. (a) showed all estimated $T_{inf}$ from the Kavanau model and MMRT without constraints for the realistic temperature range in $T_{inf}$. More than half of $T_{inf}$ estimates from Kavanau model sits outside the realistic range while MMRT provides better estimates on $T_{inf}$. (b) compared the $T_{inf}$ estimates from the Kavanau model and MMRT within the realistic range (<50 ℃).
Figure S2 The temperature dependences of $\Delta G^\circ$ in leaf respiration across 5 urban species including *F. virens* (circles, A-D), *F. altissima* (squares, E-I), *M. alba* (triangles, J-N), *E. apiculatus* (diamonds, O-S), and *C. burmannii* (pentagrams, T-W). $\Delta G^\circ$ is determined by the absolute rate function Eq. 2 based on the measurements for each temperature response curve (23 in total). Both the Kavanau (black line) and MMRT (red line) can predict the change of $\Delta G^\circ$. MMRT only predict the $\Delta G^\circ$ when $\Delta C_p^\circ < 0$, where the last measurement (panel w) has $\Delta C_p^\circ > 0$ thus no valid $\Delta G^\circ$ prediction from MMRT.