Table 5 Theoretical calculation of minimum Rubisco necessary for growth

μ = specific growth rate (s^{-1} or d^{-1})
X = cell number per l (cells l^{-1})
M = cell biomass (g $cell^{-1}$)
Rub = mol Rubisco per cell (mol Rubisco $cell^{-1}$)
$R = K^{c}_{cat}$ of a Rubisco active site (turnover rate, carbons fixed active $site^{-1}$ s^{-1})
C_{min} = concentration of Rubisco as a fraction of total protein
This can be rewritten as $(Rub) = 6.06 \times 10^{-7}(C_{min} M)$

Assumptions:
All eight Rubisco active sites are active at once
The molecular weight of Form 1 Rubisco is 550 kDa
1/3 of carbon fixed by Rubisco is lost as respiration (24 h light, J. Goldman, pers. comm.)
1/2 of biomass (M) is carbon (Falkowski & Raven, 2007)
1/3 of biomass (M) is protein (Falkowski & Raven, 2007)

Calculation:
Total carbon fixed per cell in 1 s (g $cell^{-1}$ s^{-1}) = $(Rub) \times 8 \times R \times 12$
Net carbon fixed (taking into account respiration) = $(Rub) \times 8 \times R \times 12 \times (2/3)$
Biomass fixed (M) (g $cell^{-1}$ s^{-1}) = $(Rub) \times 8 \times R \times 12 \times (2/3) \times 2$
Biomass fixed total (MX) (g l^{-1} s^{-1}) = $(Rub) \times 8 \times R \times 12 \times (2/3) \times 2 \times X$
$C_{min} = 5.5 \times 10^{5}(Rub)/(M/3)$
If we substitute $(Rub) = 6.06 \times 10^{-7}(C_{min} M)$
Biomass fixed total (MX) (g l^{-1} s^{-1}) = $7.75 \times 10^{-5} C_{min} RMX$

Divide by MX to get μ:
$\mu (s^{-1}) = 7.75 \times 10^{-5} C_{min}R$
$\mu (d^{-1}) = 7.75 \times 10^{-5} \times C_{min}R \times 86\,400$
$C_{min} = 0.15 \times (\mu/R)$
If we assume a μ (d^{-1}) of 1.2 and $R = 3$, $C_{min} = 0.06$ or 6% of total protein
If we assume a μ (d^{-1}) of 0.3 and $R = 3$, $C_{min} = 0.015$ or 1.5% of total protein
*We note that this result is sensitive to changes in the proportion of carbon and protein to total biomass.