The GNFW profile gives $P(r)$ as a shape function $p(r)$ times a normalization P_{500} that is completely determined by M_{500}:

$$\begin{aligned} P(r) &= 1.65 \times 10^{-3} h(z)^{8/3} \left[\frac{M_{500}}{3 \times 10^{14} h_{70}^{-1} M_\odot} \right]^{2/3+\alpha_P} \\ &\times \; p(r)\, h_{70}^2 \,\mathrm{keV\,cm^{-3}}, \end{aligned} \tag{1}$$

For any radial model, the pressure can be integrated to give $Y_{sph}(R)$:

$$Y_{sph}(R) = \frac{\sigma_T}{m_e c^2} \int_0^R P(r)\, dV \tag{2}$$

and similarly $M_{gas}(R)$:

$$M_{gas}(R) = m_p \mu_e \left(\frac{m_e c^2}{k_B T_e} \right) \left(\frac{1}{\sigma_T} \right) Y_{sph}(R) \tag{3}$$

What I am doing is using the self-similarity arguments that go into determining P_{500} (and hence the normalization of $P(r)$ above) to compute R_{500} from the input M_{500}:

$$M_{500} = 500 \rho_c(z) \frac{4\pi}{3} {R_{500}}^3 \tag{4}$$

and the characteristic temperature:

$$kT_{500} = \mu m_p \frac{G M_{500}}{2 R_{500}} \tag{5}$$

and calculating $M_{tot}(R_{500}) = \frac{1}{f_{gas}} M_{gas}(R_{500})$ via Eq 4.

This is what I'm comparing to the input M_{500} and determining that I have to apply that scale factor to make them agree.