e, μ, and τ neutrinos are in contact with electrons and positrons via the following reactions.

$$\begin{array}{ll} e^- + \nu_i \leftrightarrow e^- + \nu_i & e^- + \bar{\nu}_i \leftrightarrow e^- + \bar{\nu}_i \\ e^+ + \nu_i \leftrightarrow e^+ + \nu_i & e^+ + \bar{\nu}_i \leftrightarrow e^+ + \bar{\nu}_i \\ e^- + e^+ \leftrightarrow \nu_i + \bar{\nu}_i & \end{array}$$

and each other via

$$\begin{array}{ll} \nu_i + \nu_i \leftrightarrow \nu_i + \nu_i & \nu_i + \bar{\nu}_i \leftrightarrow \nu_i + \bar{\nu}_i \\ \nu_i + \nu_j \leftrightarrow \nu_i + \nu_j & \nu_i + \bar{\nu}_j \leftrightarrow \nu_i + \bar{\nu}_j \\ \nu_i + \bar{\nu}_i \leftrightarrow \nu_j + \bar{\nu}_j & \end{array}$$

But these weak reactions have a much slower rate than electromagnetic reactions like

$$e^- + e^+ \quad \leftrightarrow \quad 2\gamma$$

So the effect of the weak reactions is usually ignored.

The transfer of energy from $e^{\pm}$ to $\nu_i,\ \bar{\nu}_i$ is accounted for in the energy conservation equation

$$
\begin{aligned}
0 &= \dot{\rho}_{total} + 3\frac{\dot{R}}{R}(\rho_{total} + P_{total}) \\
\dot{\rho}_{e+\gamma} &= -4\frac{\dot{R}}{R}\rho_\gamma - 3\frac{\dot{R}}{R}(\rho_e + P_e) - (\dot{\rho}_\nu + 4\frac{\dot{R}}{R}\rho_\nu) \\
\dot{\rho}_{e+\gamma} &= -4\frac{\dot{R}}{R}\rho_\gamma - 3\frac{\dot{R}}{R}(\rho_e + P_e) - \frac{1}{R^4}\frac{d(\rho_\nu R^4)}{dt}
\end{aligned} \tag{1}
$$

The neutrino energy density (using momentum p scaled to $(pR)/(kT_N)$, $T_N = 1.946$ K):

$$
\rho_\nu = \frac{15}{\pi^4} a \left(\frac{T_N}{R}\right)^4 \int dp p^3 f_\nu(p) \tag{2}
$$

$$
\dot{\rho}_\nu = -4\frac{\dot{R}}{R}\rho_\nu + \frac{15}{\pi^4} a \left(\frac{T_N}{R}\right)^4 \int dp p^3 \dot{f}_\nu(p) \tag{3}
$$

The equation for the expansion coefficient R

$$
\begin{aligned}
\alpha &= \ln(R) \\
\dot{\alpha} = \frac{\dot{R}}{R} &= \sqrt{\frac{8}{3}\pi G(\rho_{e+\gamma} + \rho_\nu)}
\end{aligned} \tag{4}
$$

is not affected overall.

The final mass fraction $X_{^4He}$ of Helium-4 depends on how much the neutron-proton conversion rates destroy neutrons by the time of Nucleosynthesis ($T \approx 0.8$ GK).

$$
\begin{aligned}
\lambda(n + \nu_e \rightarrow p + e^-) &= A \int v_e E_e^2 p_{\nu_e}^2 dp_{\nu_e} f_{\nu_e} (1 - f_e) \\
\lambda(n + e^+ \rightarrow p + \bar{\nu}_e) &= A \int p_{\nu_e}^2 p_e^2 dp_e f_e (1 - f_{\nu_e}) \\
\lambda(n \rightarrow p + e^- + \bar{\nu}_e) &= A \int v_e p_{\nu_e}^2 E_e^2 dp_{\nu_e} (1 - f_{\nu_e})(1 - f_e) \\
\lambda(p + e^- \rightarrow n + \nu_e) &= A \int p_{\nu_e}^2 p_e^2 dp_e f_e (1 - f_{\nu_e}) \\
\lambda(p + \bar{\nu}_e \rightarrow n + e^+) &= A \int v_e E_e^2 p_{\nu_e}^2 dp_{\nu_e} f_{\nu_e} (1 - f_e) \\
\lambda(p + e^- + \bar{\nu}_e \rightarrow n) &= A \int v_e p_{\nu_e}^2 E_e^2 dp_{\nu_e} f_{\nu_e} f_e
\end{aligned}
$$

The conversion rates depend on f_{ν_e} and f_e