potential	variables	equations of state	Maxwell relations
internal energy U	$S, X, \{N_j\}$	$\left(\frac{\partial U}{\partial S}\right)_{X,\{N_j\}} = T$ $\left(\frac{\partial U}{\partial X}\right)_{S,\{N_j\}} = Y$ $\left(\frac{\partial U}{\partial N_j}\right)_{S,X,\{N_{i\neq j}\}} = \mu'_j$	$\left(\frac{\partial T}{\partial X}\right)_{S,\{N_j\}} = \left(\frac{\partial Y}{\partial S}\right)_{X,\{N_j\}}$ $\left(\frac{\partial T}{\partial N_j}\right)_{S,X,\{N_{i\neq j}\}} = \left(\frac{\partial \mu'_j}{\partial S}\right)_{X,\{N_i\}}$ $\left(\frac{\partial Y}{\partial N_j}\right)_{S,X,\{N_{i\neq j}\}} = \left(\frac{\partial \mu'_j}{\partial X}\right)_{S,\{N_i\}}$ $\left(\frac{\partial \mu'_j}{\partial N_i}\right)_{S,X,\{N_{k\neq i}\}} = \left(\frac{\partial \mu'_i}{\partial N_j}\right)_{S,X,\{N_{k\neq j}\}}$
enthalpy H	$S, Y, \{N_j\}$	$\left(\frac{\partial H}{\partial S}\right)_{Y,\{N_j\}} = T$ $\left(\frac{\partial H}{\partial Y}\right)_{S,\{N_j\}} = -X$ $\left(\frac{\partial H}{\partial N_j}\right)_{S,Y,\{N_{i\neq j}\}} = \mu'_j$	$\left(\frac{\partial T}{\partial Y}\right)_{S,\{N_j\}} = -\left(\frac{\partial X}{\partial S}\right)_{Y,\{N_j\}}$ $\left(\frac{\partial T}{\partial N_j}\right)_{S,Y,\{N_{i\neq j}\}} = \left(\frac{\partial \mu'_j}{\partial S}\right)_{Y,\{N_i\}}$ $\left(\frac{\partial X}{\partial N_j}\right)_{S,Y,\{N_{i\neq j}\}} = -\left(\frac{\partial \mu'_j}{\partial Y}\right)_{S,\{N_i\}}$ $\left(\frac{\partial \mu'_j}{\partial N_i}\right)_{S,Y,\{N_{k\neq i}\}} = \left(\frac{\partial \mu'_i}{\partial N_j}\right)_{S,Y,\{N_{k\neq j}\}}$
Helmholtz free energy F	$T, X, \{N_j\}$	$\left(\frac{\partial F}{\partial T}\right)_{X,\{N_j\}} = -S$ $\left(\frac{\partial F}{\partial X}\right)_{T,\{N_j\}} = Y$ $\left(\frac{\partial F}{\partial N_j}\right)_{T,X,\{N_{i\neq j}\}} = \mu'_j$	$\left(\frac{\partial S}{\partial X}\right)_{T,\{N_j\}} = -\left(\frac{\partial Y}{\partial T}\right)_{X,\{N_j\}}$ $\left(\frac{\partial S}{\partial N_j}\right)_{T,X,\{N_{i\neq j}\}} = -\left(\frac{\partial \mu'_j}{\partial T}\right)_{X,\{N_i\}}$ $\left(\frac{\partial Y}{\partial N_j}\right)_{T,X,\{N_{i\neq j}\}} = \left(\frac{\partial \mu'_j}{\partial X}\right)_{T,\{N_i\}}$ $\left(\frac{\partial \mu'_j}{\partial N_i}\right)_{T,X,\{N_{k\neq i}\}} = \left(\frac{\partial \mu'_i}{\partial N_j}\right)_{T,X,\{N_{k\neq j}\}}$
Gibbs free energy G	$T, Y, \{N_j\}$	$\left(\frac{\partial G}{\partial T}\right)_{Y,\{N_j\}} = -S$ $\left(\frac{\partial G}{\partial Y}\right)_{T,\{N_j\}} = -X$ $\left(\frac{\partial G}{\partial N_j}\right)_{T,Y,\{N_{i\neq j}\}} = \mu'_j$	$\left(\frac{\partial S}{\partial Y}\right)_{T,\{N_j\}} = \left(\frac{\partial X}{\partial T}\right)_{Y,\{N_j\}}$ $\left(\frac{\partial S}{\partial N_j}\right)_{T,Y,\{N_{i\neq j}\}} = -\left(\frac{\partial \mu'_j}{\partial T}\right)_{Y,\{N_i\}}$ $\left(\frac{\partial X}{\partial N_j}\right)_{T,Y,\{N_{i\neq j}\}} = -\left(\frac{\partial \mu'_j}{\partial Y}\right)_{T,\{N_i\}}$ $\left(\frac{\partial \mu'_j}{\partial N_i}\right)_{T,Y,\{N_{k\neq i}\}} = \left(\frac{\partial \mu'_i}{\partial N_j}\right)_{T,Y,\{N_{k\neq j}\}}$
Grand potential Ω	$T, X, \{\mu'_j\}$	$\left(\frac{\partial \Omega}{\partial T}\right)_{X,\{\mu'_j\}} = -S$ $\left(\frac{\partial \Omega}{\partial X}\right)_{T,\{\mu'_j\}} = Y$ $\left(\frac{\partial \Omega}{\partial \mu'_j}\right)_{T,X,\{\mu'_{i\neq j}\}} = -N_j$	$\left(\frac{\partial S}{\partial X}\right)_{T,\{\mu'_j\}} = -\left(\frac{\partial Y}{\partial T}\right)_{X,\{\mu'_j\}}$ $\left(\frac{\partial S}{\partial \mu'_j}\right)_{T,X,\{\mu'_{i\neq j}\}} = \left(\frac{\partial N_j}{\partial T}\right)_{X,\{\mu'_i\}}$ $\left(\frac{\partial Y}{\partial \mu'_j}\right)_{T,X,\{\mu'_{i\neq j}\}} = -\left(\frac{\partial N_j}{\partial X}\right)_{T,\{\mu'_i\}}$ $\left(\frac{\partial N_j}{\partial \mu'_i}\right)_{T,X,\{\mu'_{k\neq i}\}} = \left(\frac{\partial N_i}{\partial \mu'_j}\right)_{T,X,\{\mu'_{k\neq j}\}}$

If a set of natural variables is held constant, irreversible processes always decrease the corresponding potential. The corresponding potential takes a minimum in thermodynamic equilibrium.