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- Above the LFC, the parcel will eventually become negatively buoyant at its *level of neutral buoyancy* (LNB), also called the *equilibrium level* (EL).

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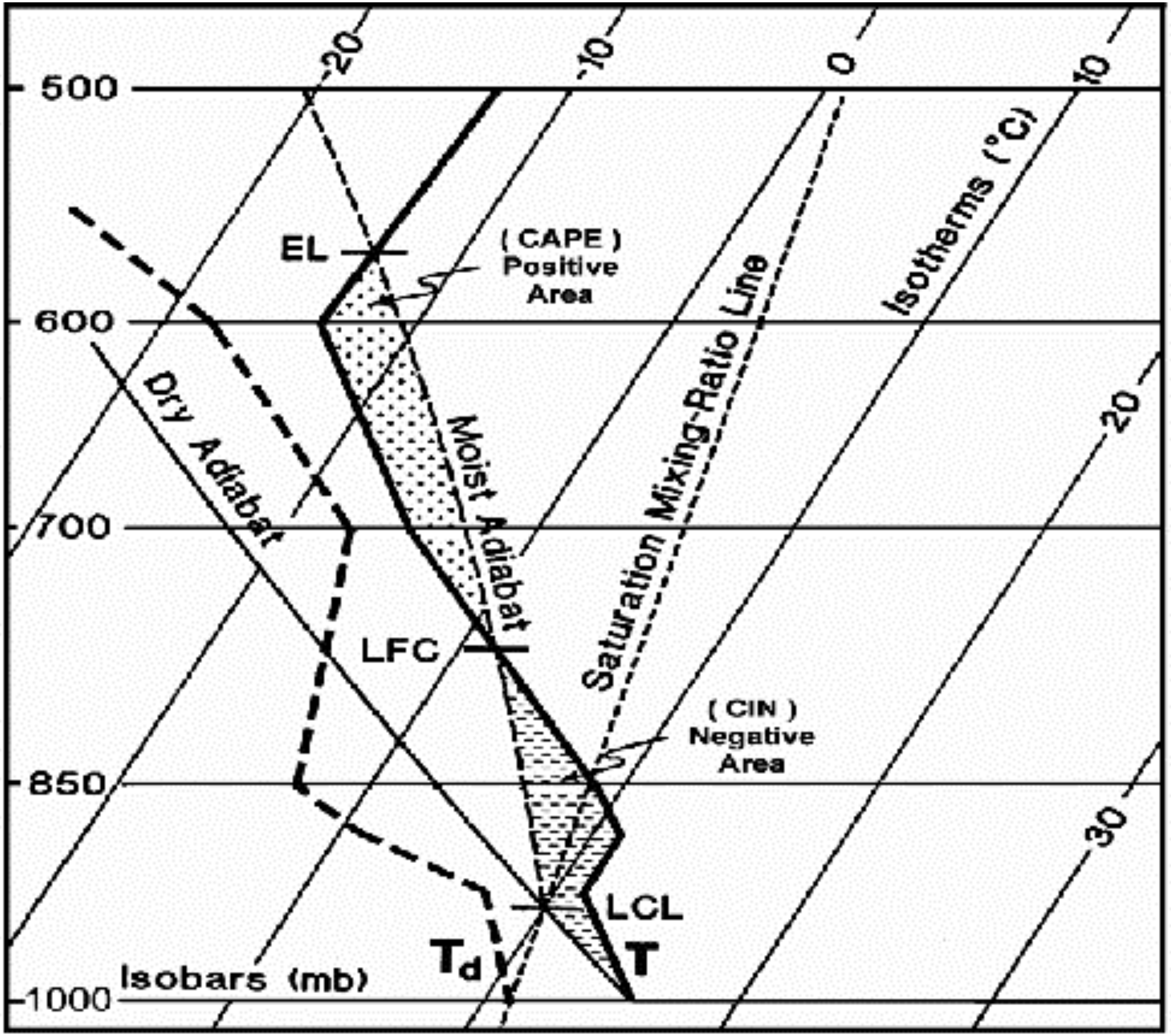
- Above the LFC, the parcel will eventually become negatively buoyant at its *level of neutral buoyancy* (LNB), also called the *equilibrium level* (EL).
- The parcel will overshoot, then oscillate about this level.


500
600
700
850
1000
-20
-10
0
10
20
30
EL
(CAPE)
Positive
Area
Moist Adiabat
Saturation Mixing-Ratio Line
Isotherms (°C)
Dry Adiabat
LFC
(CIN)
Negative
Area
LCL
T
Td
Isobars (mb)

Convective Available Potential Energy (CAPE) is proportional to the area between a sounding and the parcel's temperature plotted on a skew T-log p diagram.

CAPE depends on the parcel properties, which in turn depend on the parcel's originating level.

Thus,

$$\mathrm{CAPE}_i \equiv \int_{z_i}^{\mathrm{LNB}} g\frac{T - \bar{T}}{\bar{T}}\,dz = \int_{p_n}^{p_i} R(T - \bar{T})\,d\ln p,$$

where z_i is the parcel's initial height, p_i its initial pressure, and p_n the pressure at the LNB.

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Exercise. Derive CAPE_i from (41):

$$\frac{dw}{dt} = g\frac{T-\bar{T}}{\bar{T}}.$$

We can also define *negative area* (NA) and *positive area* (PA):

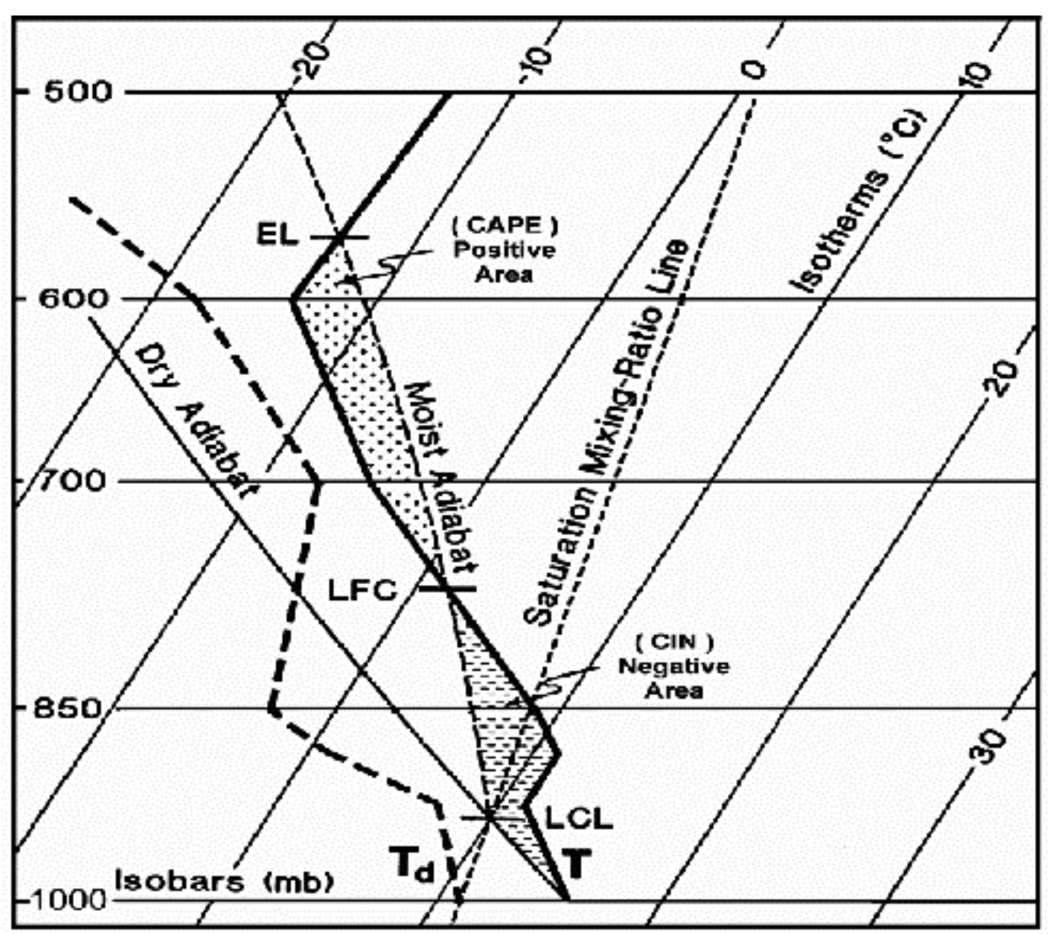
$$\mathrm{NA}_i \equiv -\int_{p_f}^{p_i} R(T-\bar{T})\, d\ln p,$$

$$\mathrm{PA}_i \equiv \int_{p_n}^{p_f} R(T-\bar{T})\, d\ln p,$$

so

$$\mathrm{CAPE}_i = \mathrm{PA}_i - \mathrm{NA}_i.$$

Here, p_f is the pressure at the LFC.



- The negative area is the amount of vertical kinetic energy per unit mass required for a parcel to reach the LFC from z_i.
  - In this case, $w_f = 0$ and $w_i^2/2 = NA_i$.
- The positive area is the amount of vertical kinetic energy per unit mass that is acquired by the parcel as it ascends from the LFC to LNB/EL.
  - If $w_{\mathrm{LFC}} = 0$, then $w_n^2/2 = PA_i$.
- In particular, the maximum updraft speed (which is attained at the LNB/EL) is then just

$$w_n = \sqrt{2\mathrm{PA_i}}.$$