Given:
A coal burning steam power plant produces a net power of 300 MW with an overall thermal efficiency of 32%. The actual air-fuel ratio in the furnace is calculated to be 12:1 (air:fuel). The heating value of the coal is 28,000 kJ/kg.

Required:
Determine the amount of coal consumed during a 24 hour period and the rate of air flowing through the furnace.

Solution:
The net work out of the power plant is defined as

$$\dot{W}_{net,out} := 300\ \text{MW}$$

The thermal efficiency is defined as

$$\eta_{th} := 32\ \%$$

The air to fuel ratio is defined as

$$r_{af} := \frac{12\ \text{kg}}{1\ \text{kg}}$$

The heating value of the coal is defined as

$$HV := 28000\ \frac{\text{kJ}}{\text{kg}}$$

The period of interest is defined as

$$\Delta t := 24\ \text{hr}$$

From the definition of thermal efficiency, the heat supplied to the furnace is

$$\eta_{th} = \frac{\dot{W}_{netout}}{\dot{Q}_H} \quad \text{or} \quad \dot{Q}_H := \frac{\dot{W}_{net,out}}{\eta_{th}} = 937.5\ \text{MW}$$

The rate at which coal is consumed is then given by

$$\dot{m}_{coal} := \frac{\dot{Q}_H}{HV} = 33.48\ \frac{\text{kg}}{\text{s}}$$

The total amount of coal consumed in a 24 hour period is then given by

$$m_{coal} := \dot{m}_{coal} \cdot \Delta t = 2.893 \cdot 10^{6}\ \text{kg}$$

The rate of air flowing through the furnace is then given by

$$\dot{m}_{air} := r_{af} \cdot \dot{m}_{coal} = 401.8\ \frac{\text{kg}}{\text{s}}$$

Additionally, the heat rejected by the furnace may be found by

$$\dot{Q}_L := \dot{Q}_H - \dot{W}_{net,out} = 637.5\ \text{MW}$$