



Chimney stack assumptions

Chimney stack dimensions

Diameter	3,00	m
Radius	1,50	m
Cross section	7,07	m ²

Air velocity

45,00	km/ h
0,75	km/ min
0,0125	km/ s
12,50	m/ s

Air displacement

318.000,00	m ³ / h
5.300,00	m ³ / min
88,33	m ³ / s
44.996,29	m/ h
45,00	km/ h

Estimated energy loss through the chimney stack

Assumptions:

- Outside air temperature 10 °C;
- 10 g water vapour/m³ in the air supplied;
- Combustion of the natural gas adds 10 g of water vapour/m³;
- No water vapour is released during tyre manufacture;
- 1 m³ of natural gas yields 9.8 kWh of heat (this is based on Dutch low-calorific natural gas);
- CO₂ emissions are 56.6 kg/GJ (for Dutch natural gas 2017);
- The chimney stack emits 318,000 m³/h of gases at 150 °C.

Specific heat of dry air	1,0 kJ/ kg.K
Specific heat of water	4,186 kJ/ kg.K
Specific mass of air	1,29 kg/ m ³

Energy loss

$$Q = c * m * \Delta T$$

The energy loss per hour for the dry exhaust air + water vapour is therefore:

$$Q = 1,0 \text{ [kJ/kg.K]} * 318.000 \text{ [m}^3\text{]} * 1,29 \text{ [kg/ m}^3\text{]} * 140 \text{ [}^\circ\text{K]} + 4,186 \text{ [kJ/kg.K]} * 318.000 \text{ [m}^3\text{]} * 0,020 \text{ [kg/m}^3\text{]} * 140 \text{ [}^\circ\text{K]} = 57.430.800 \text{ kJ/h} + 3.727.214. \text{ Total } \mathbf{61.158.014 \text{ kJ/h}}$$

Convert to kWh:

1 kJ = 1/3600 kWh therefore means **16,988 kWh/h of energy loss** (1,734 m³ natural gas/h)

CO₂ emissions

The energy loss is 61,158 GJ/h. This brings the CO₂ emission to 61,158 [GJ/h] * 56.6 [kg/GJ] = **3,462 tons/h**
