Project Introduction

Firewood™

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1 Market Analysis

1.1 Customer Traits

It is reasonable to assume that, due to the inherent nature of the products offered by Firewood™, its customers must exhibit one common trait, namely **the need for a mobile, localised source of heat energy**. This definition, despite not immediately coming across as inherently flawed, ignroes a very important parameter of the energy source, this being the (average) thermal power output.

Consider a typical *BIC* lighter equipped with $4.5g$ of butane fuel. Said fuel amount is capable of maintaining a (more or less) constant power output throughout the duration of $30min$. The fuel source used in most lighters is *butane*. Upon combustion, one mole of said fuel releases a fixed amount of energy into the environment. This energy is defined by the *enthalpy of combustion* ...

$$\Delta H_{c(mol)} = -2.88 \cdot 10^3 \, kJ \cdot mol^{-1}$$

Given the molar mass of butane ...

$$M = 58.124 \, g \cdot mol^{-1}$$

A full tank of butane contains:

$$\begin{aligned} n &= \frac{4.5 \, g}{58.124 \, g \cdot mol^{-1}} \\ &= 7.74 \cdot 10^{-2} \, mol \end{aligned}$$

And is thus capable of delivering a fixed amount of total energy:

$$\begin{aligned} \Delta H_c &= \Delta H_{c(mol)} \cdot n \\ &= -2.23 \cdot 10^2 \, kJ \end{aligned}$$

Spreading that energy output out over a 30-minute burn time, the average power output equals ...

$$\begin{aligned} \bar{P} = \frac{E}{t} &= \frac{2.23 \cdot 10^2 \, kJ \cdot 10^3}{30min \cdot 60s} \\ &= \frac{2.23 \cdot 10^5}{1.7 \cdot 10^3} \\ &= 123.8 \, W \end{aligned}$$

Assuming that the fuel consuption is not contant, the power formula may be expressed in a continuous form:

$$P(t) = \frac{dE}{dt}$$

Thus, the average pwoer output becomes ...

$$\bar{P} = \frac{1}{T} \cdot \int_0^T P(t) \, dt$$