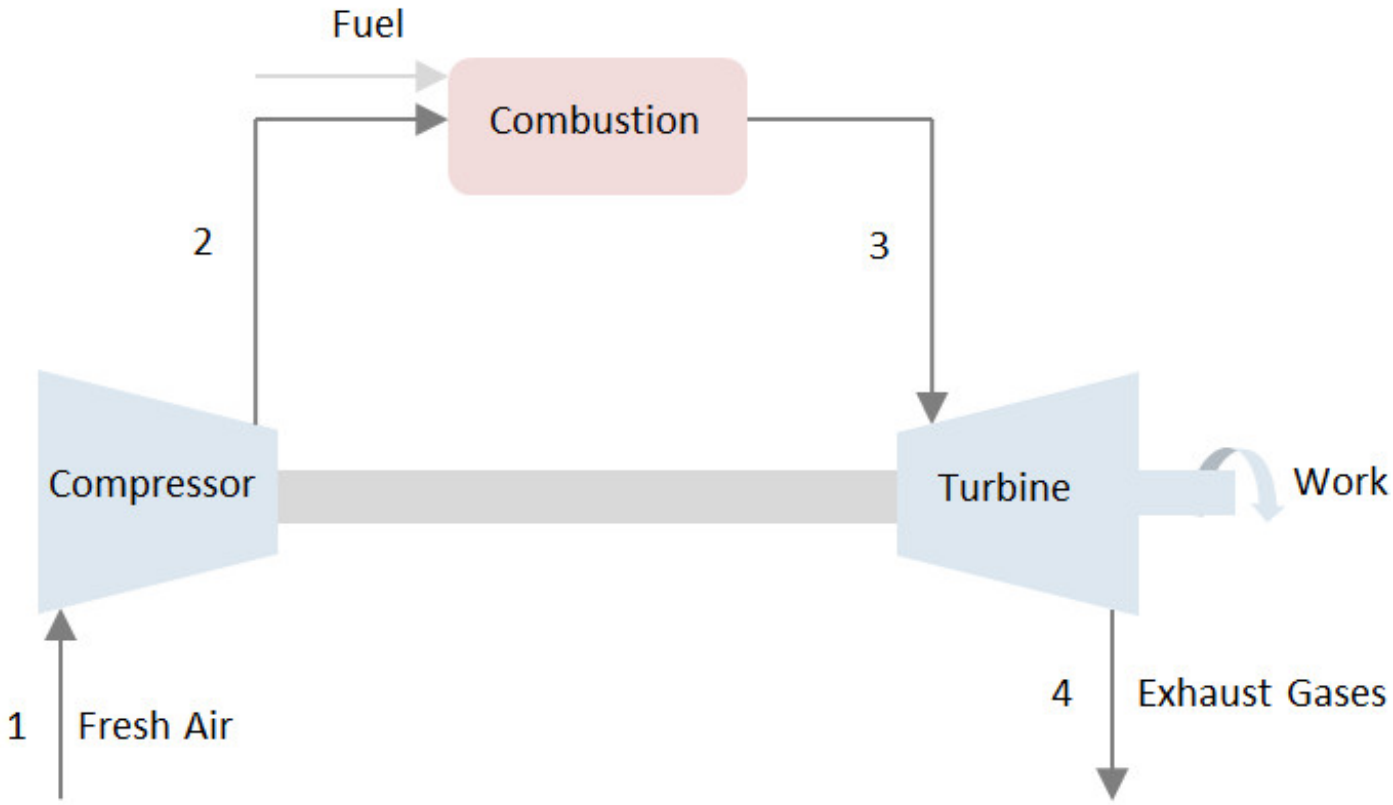
# Ideal Brayton Cycle

## Introduction

Consider this ideal Brayton cycle.




The compressor inlet temperature and pressure is 300 °C and 101 kPa, the compression ratio is 8, and the combuster outlet temperature is 1300 °C. The compressor and turbine are isentropic, and combustion is isobaric.

What is the thermal efficiency of the system?

## Parameters

```
> with(ThermophysicalData) :
  with(Units[Standard]) :
```

Compressor Inlet Temperature

```
> Tmin := 300degC :
```

Compressor Exit Temperature

```
> Tmax := 1300degC :
```

Compressor inlet pressure

> Pmin := 101 kPa :

Compressor pressure ratio

> r := 8 :

## Compressor Inlet

> P1 := Pmin :

> T1 := Tmin :

> h1 := Property( enthalpy, temperature = T1, pressure = P1, air )

$$h1 := 7.05272961410^{5}\ \frac{J}{kg}$$

> s1 := Property( entropy, temperature = T1, pressure = P1, air )

$$s1 := 4547.480132\ \frac{J}{kg\,K}$$

## Combustor Inlet

> s2 := s1 :

> P2 := r·P1 :

> T2 := Property( temperature, pressure = P2, entropy = s2, air )

$$T2 := 991.5856803\ K$$

> h2 := Property( enthalpy, temperature = T2, pressure = P2, air )

$$h2 := 1.1633210910^{6}\ \frac{J}{kg}$$

## Turbine Inlet

> P3 := P2 :

> T3 := Tmax :

> h3 := Property( enthalpy, temperature = T3, pressure = P3, air ) ;

$$h3 := 1.8518472610^{6}\ \frac{J}{kg}$$

> s3 := Property( entropy, T = T3, P = P3, air ) ;

$$s3 := 5092.509817\ \frac{J}{kg\,K}$$

## Turbine Exit

> P4 := P1 :

> s4 := s3 :

> T4 := Property( temperature, pressure = P4, entropy = s4, air )

$$T4 := 947.0939895\ K$$

> h4 := Property( enthalpy, temperature = T4, pressure = P4, air ) ;

$$h4 := 1.11242426\,10^{6}\ \frac{J}{kg}$$

## Thermal Efficiency

> $\eta := 1 - \frac{h4 - h1}{h3 - h2}$

$$\eta := 0.4086652304$$