

First Course on Power Systems

Module 2: Electric Energy and the Environment

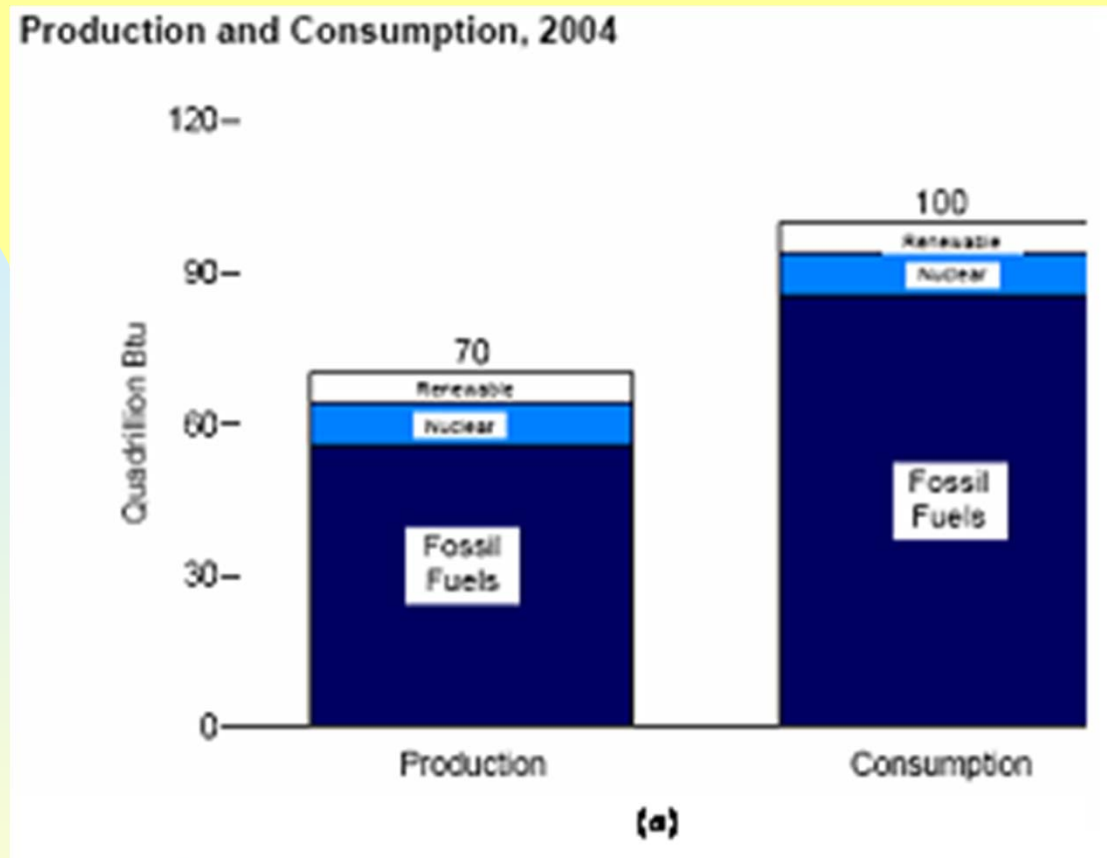
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Reference Textbook:
First Course on Power Systems by Ned Mohan,
www.mnpere.com

Module 2: Electric Energy and the Environment

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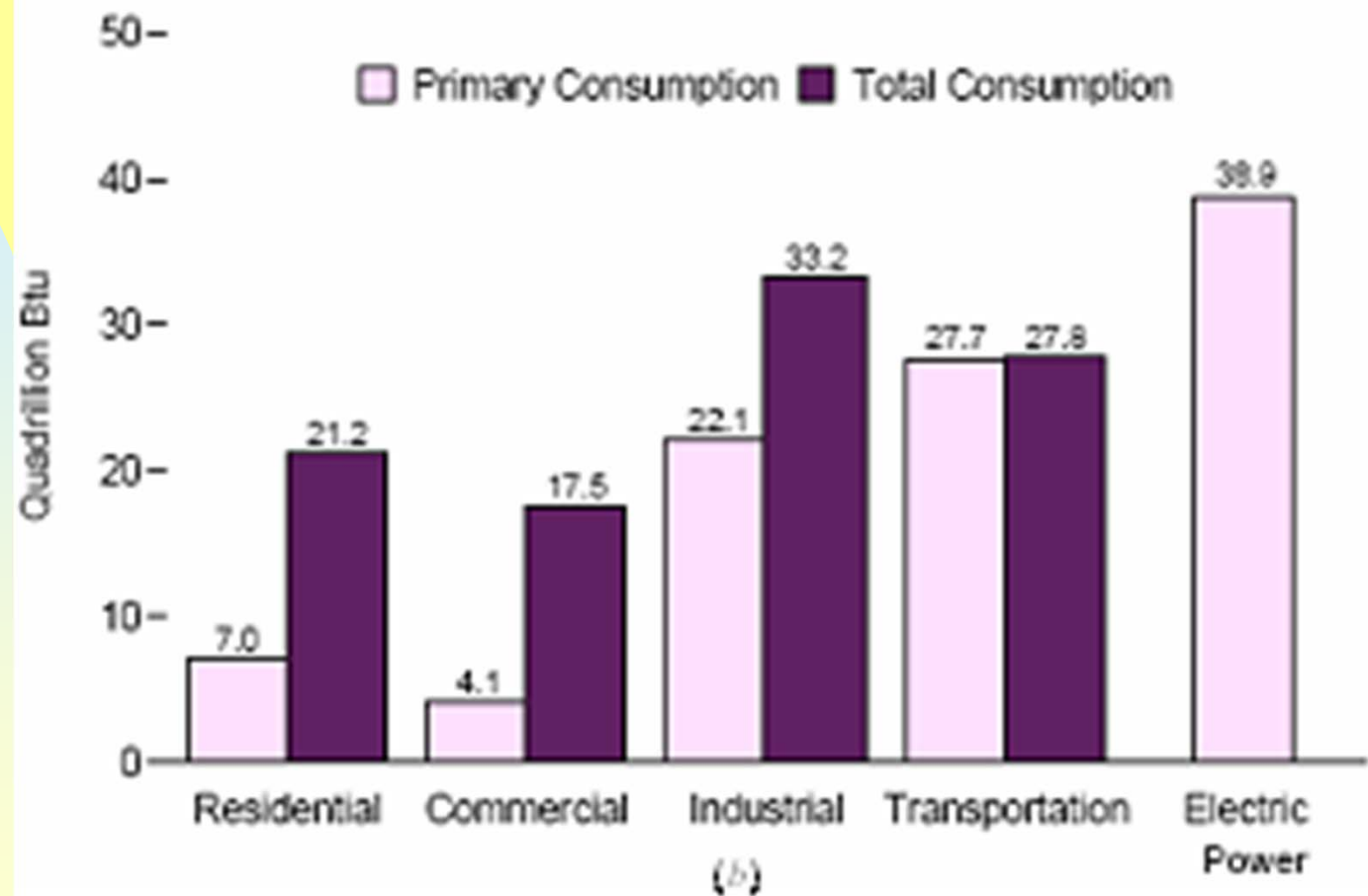
Energy Production and Consumption in the U.S.



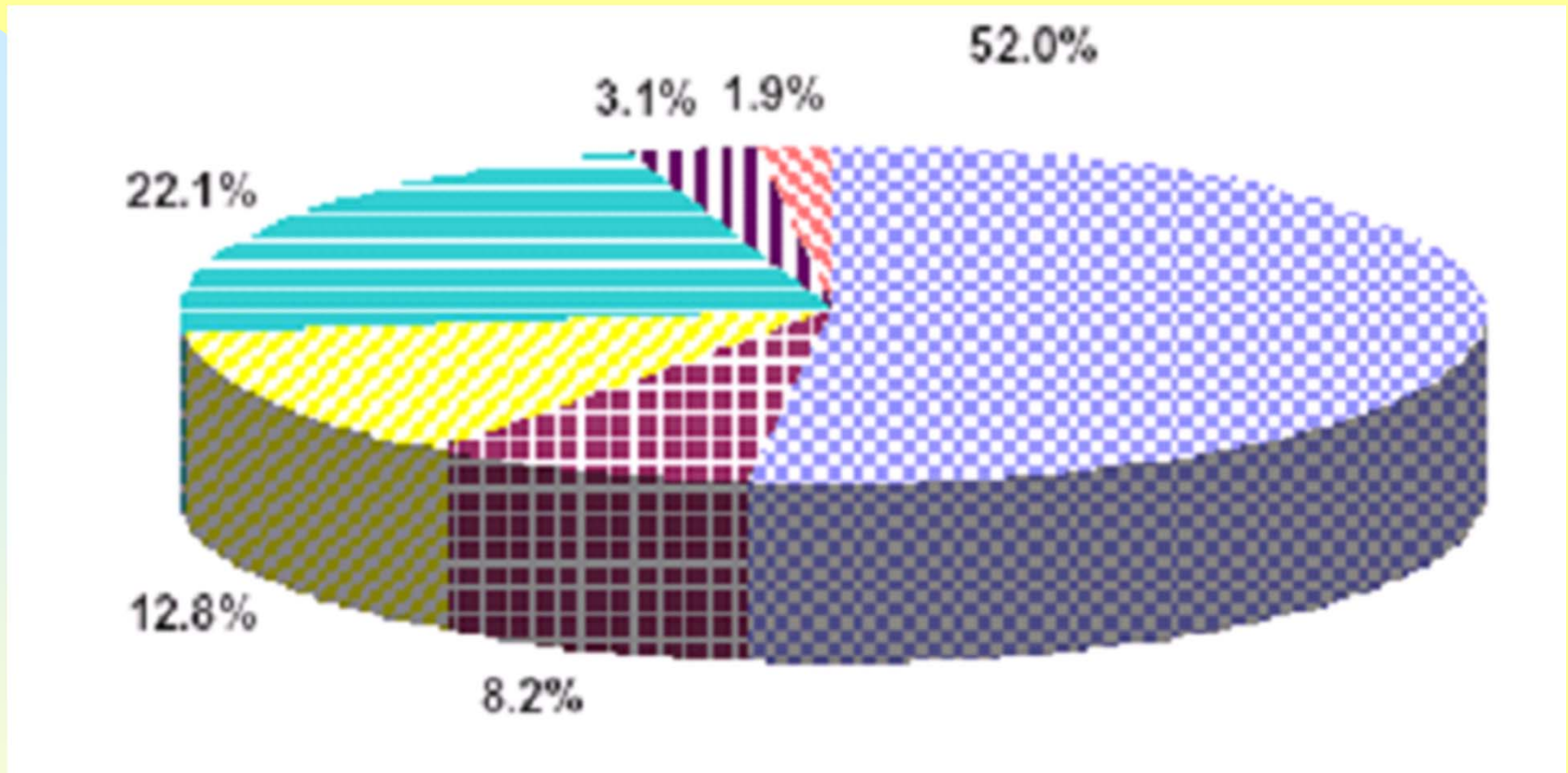
Approximately, 10,000 BTUs equal 2.93 kWh

Energy Consumption in the U.S.

Primary and Total Consumption by Sector, 2004



Power Generation by Various Fuel Types in the U.S.



- Coal
- Natural Gas
- Other Energy Sources
- Hydroelectric
- Nuclear
- Petroleum

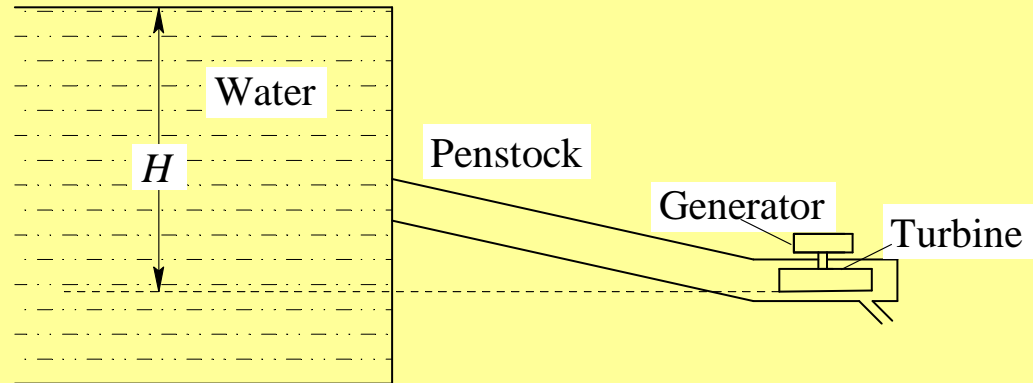
Choices:

- Hydro
- Fossil Fuels
- Nuclear
- Renewable

Consequences:

- Carbon Dioxide
- Sulfur Dioxide
- Nitrogen Dioxides
- Mercury
- Thermal pollution

Hydro Power Generation



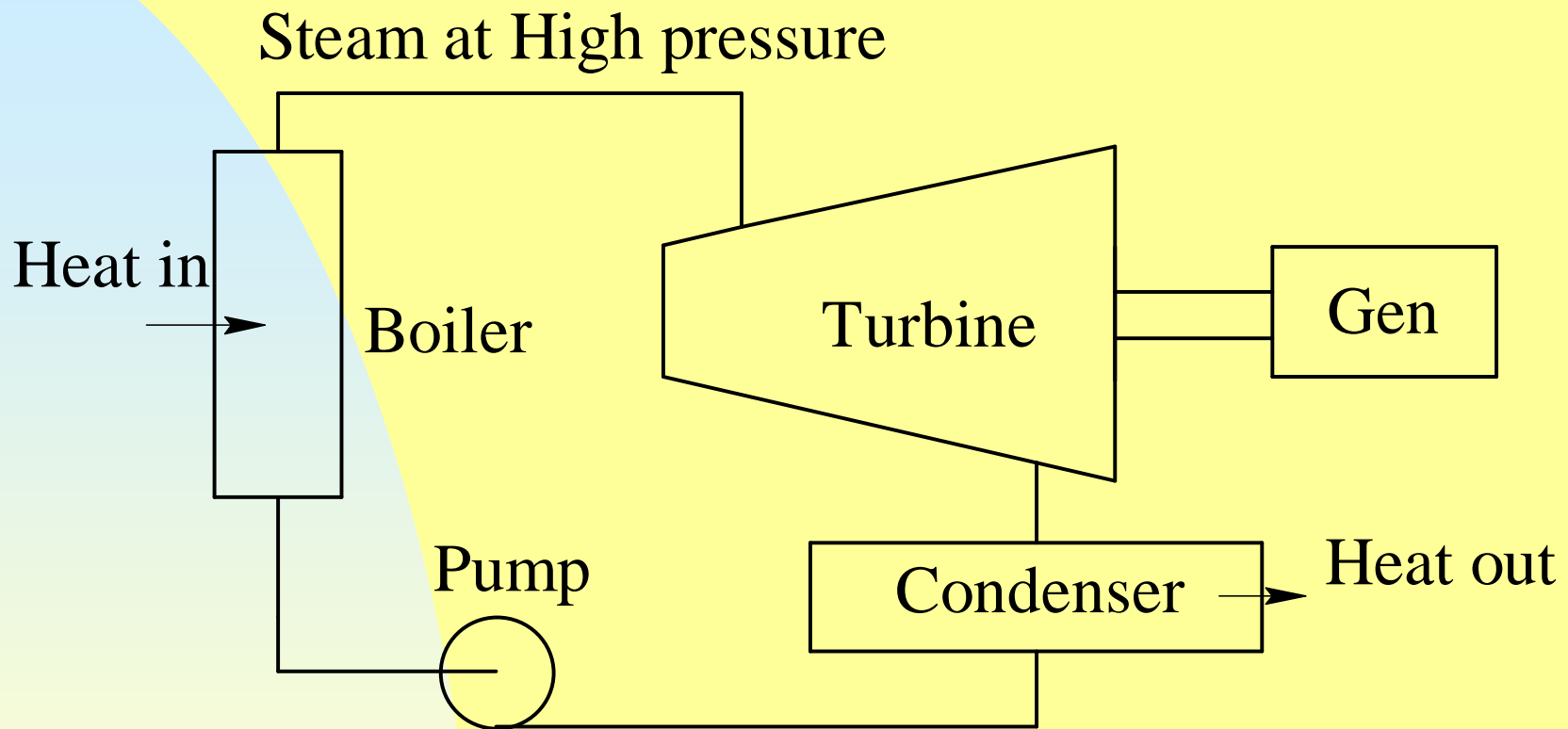
Types:

- High
- Medium
- Run-of-River

Fossil-Fuel Based Power Plants

- Coal
- Natural Gas
- Oil

Rankine Thermodynamic Cycle in Coal Plants

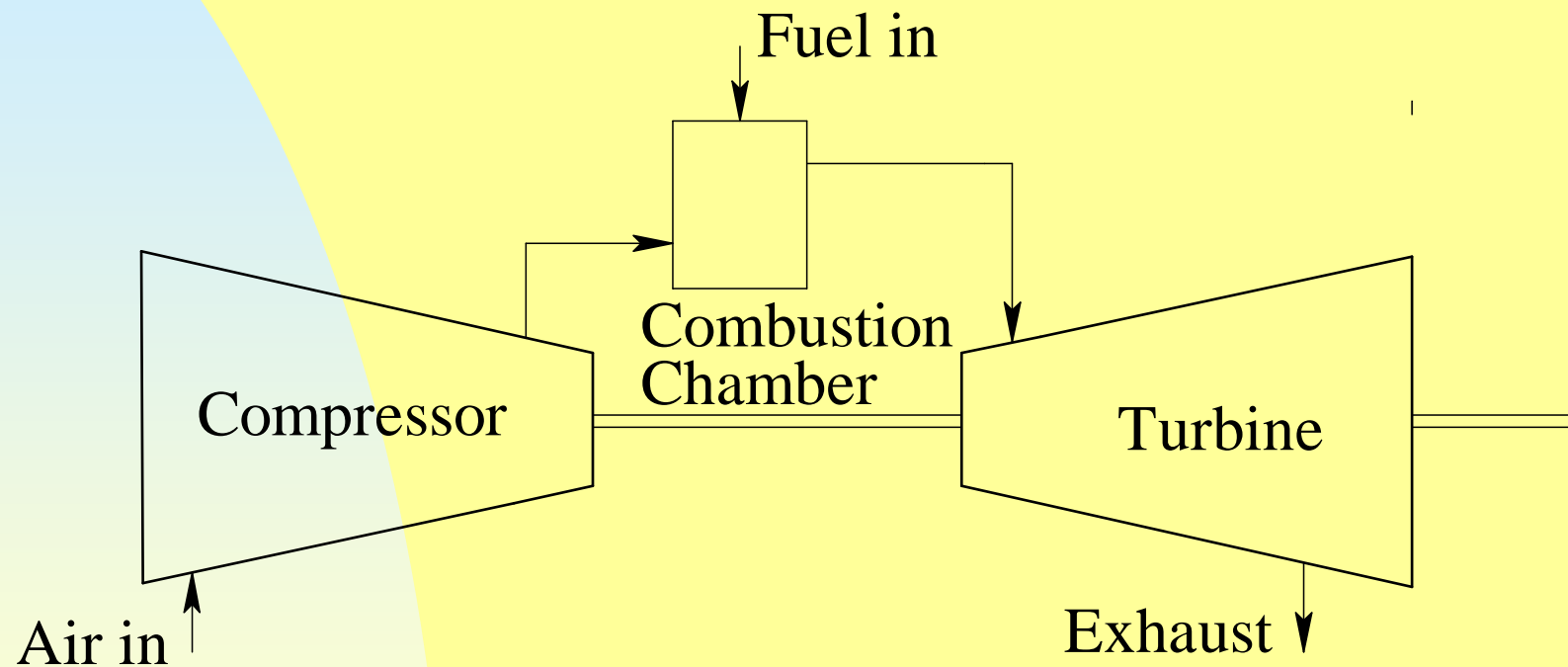


Typical Efficiency: 35-40%

Carnot Cycle:

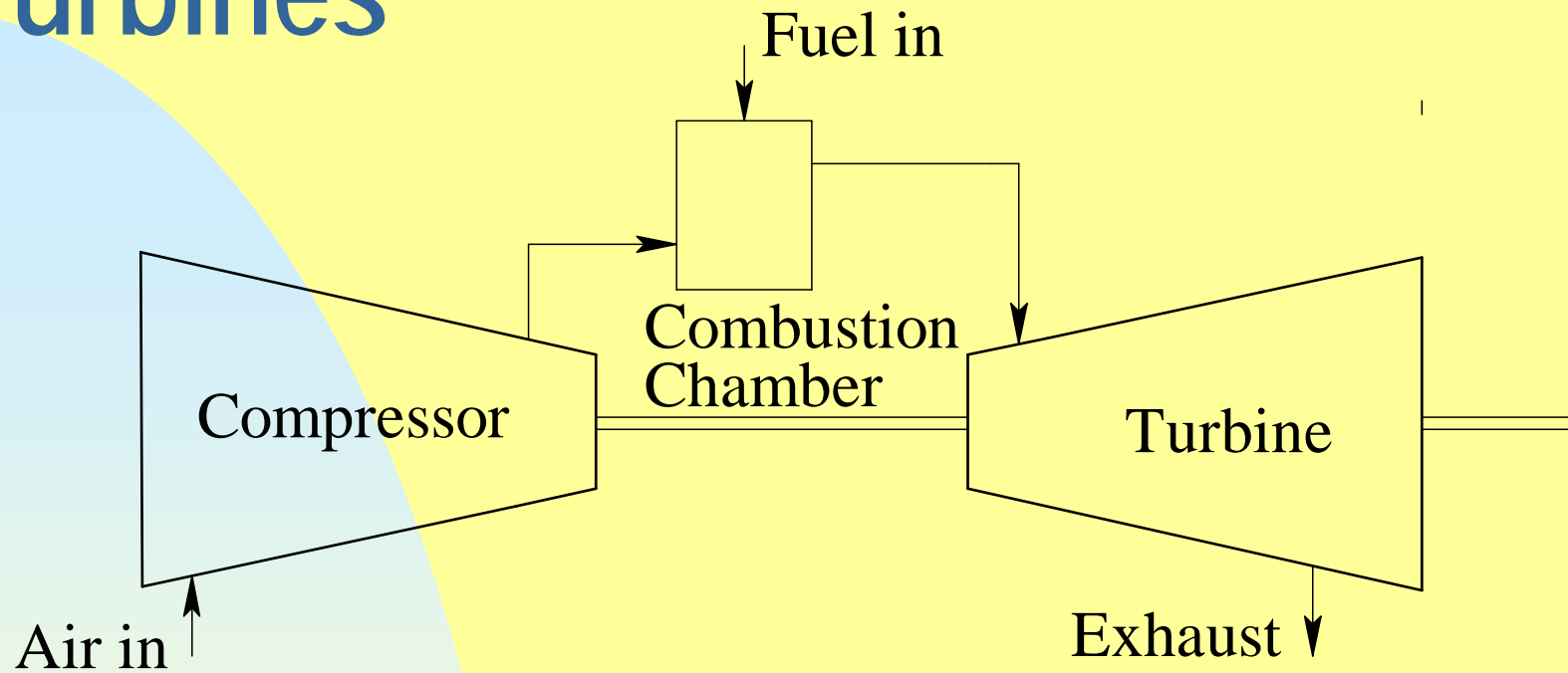
$$\eta_c = \frac{T_H - T_L}{T_H}$$

Brayton-Cycle Gas Turbines



Typical Efficiency: ~35%

Combined-Cycle Gas Turbines



Steam-based Rankine Cycle

Typical Efficiency: 55-60%