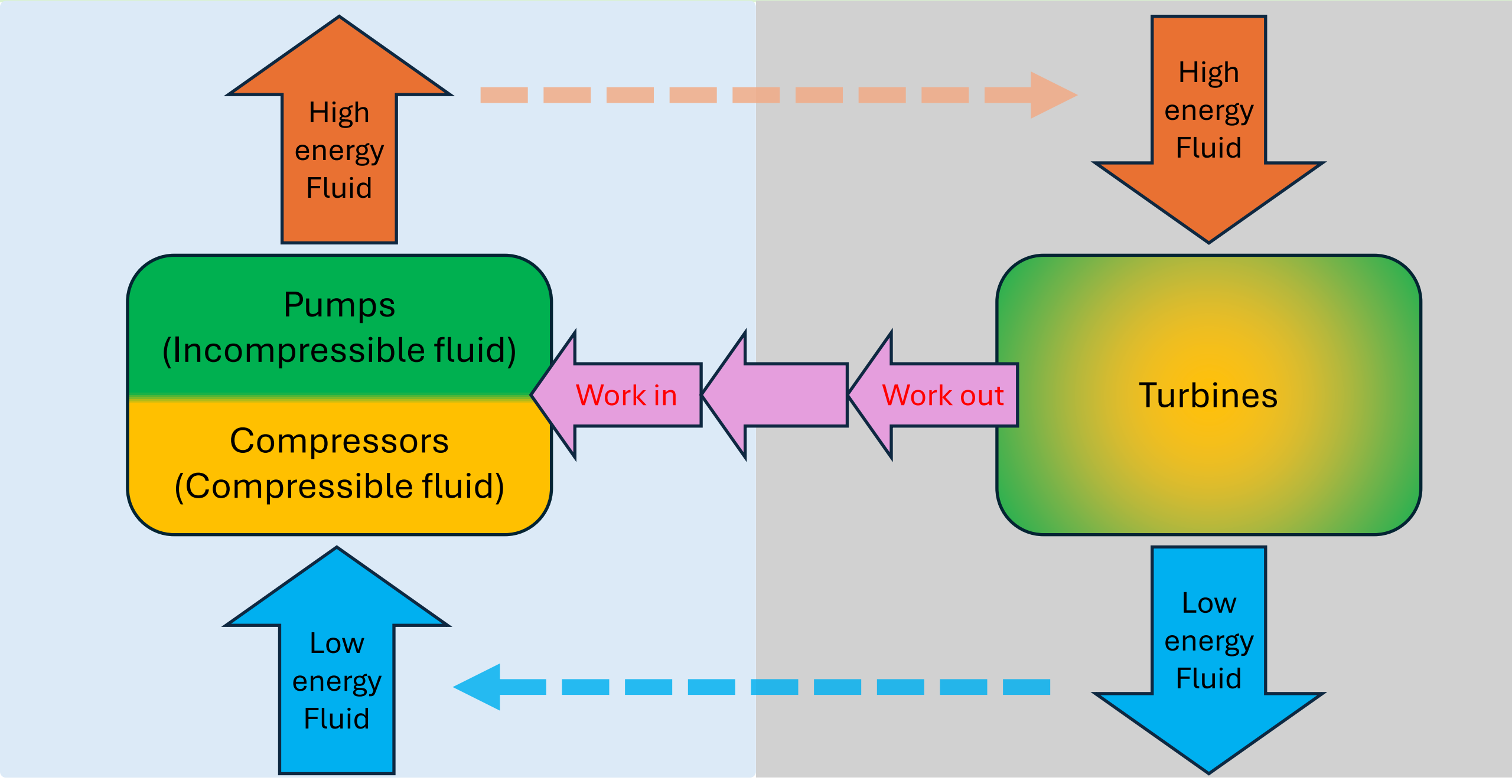
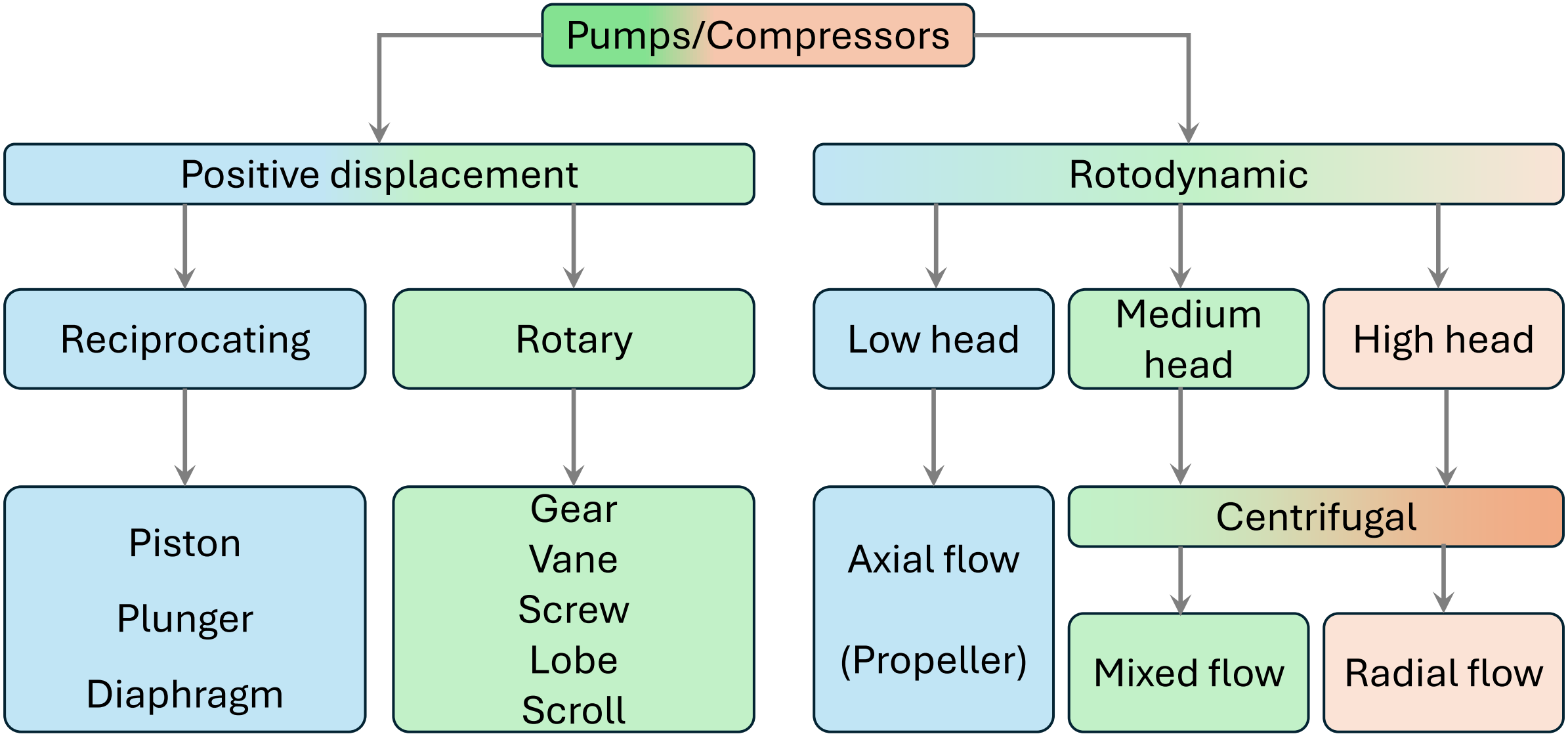
Turbo machineries



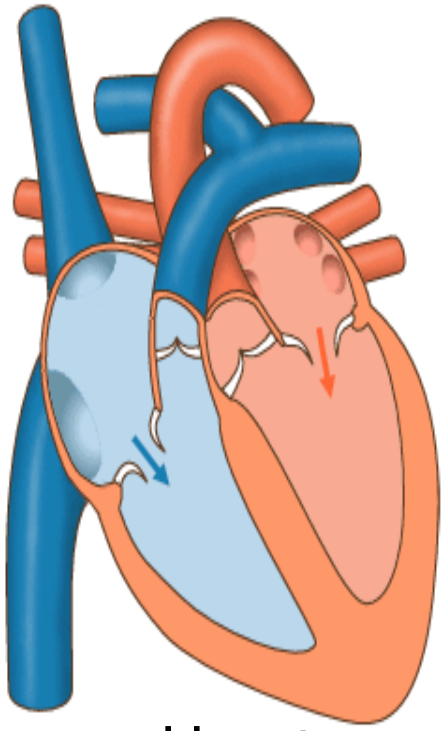
Turbo machines that takes “Work In”



Pump and compressor

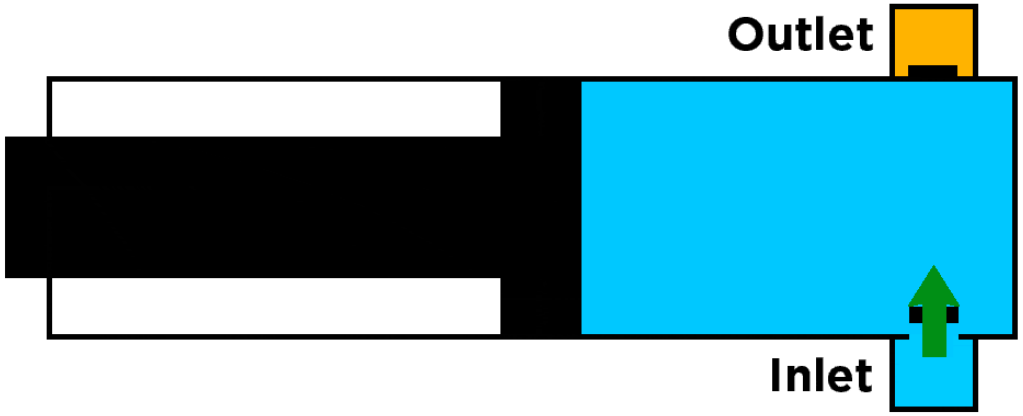
Pump

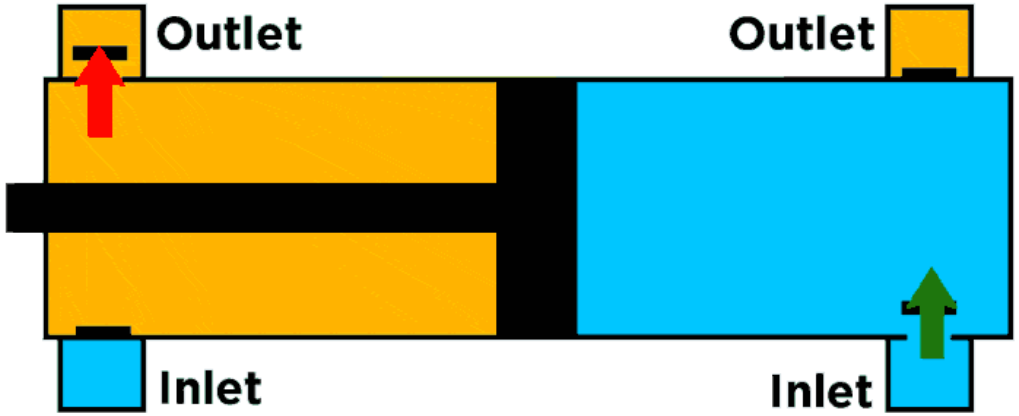
Compressor

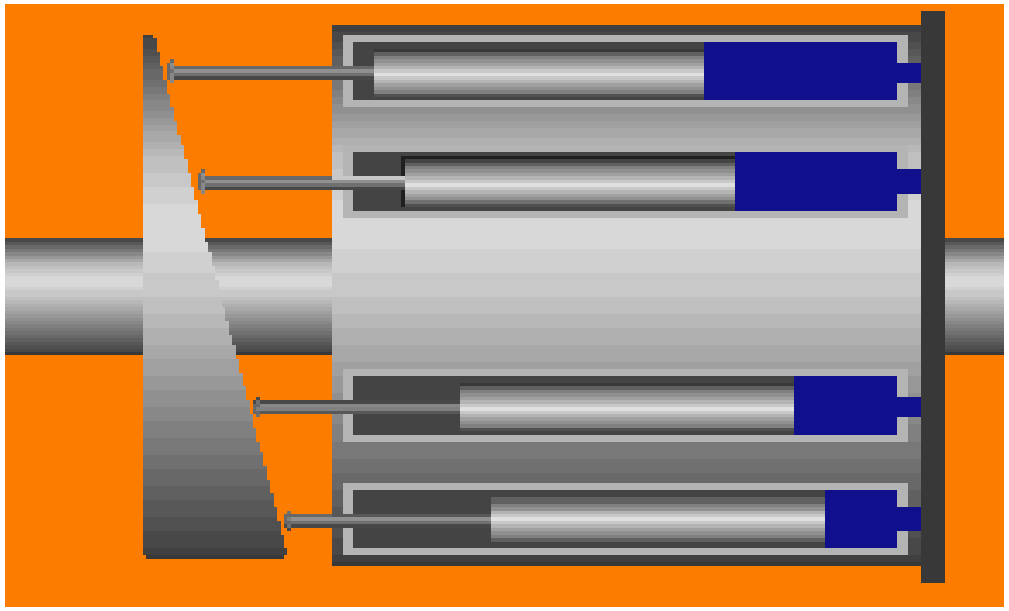


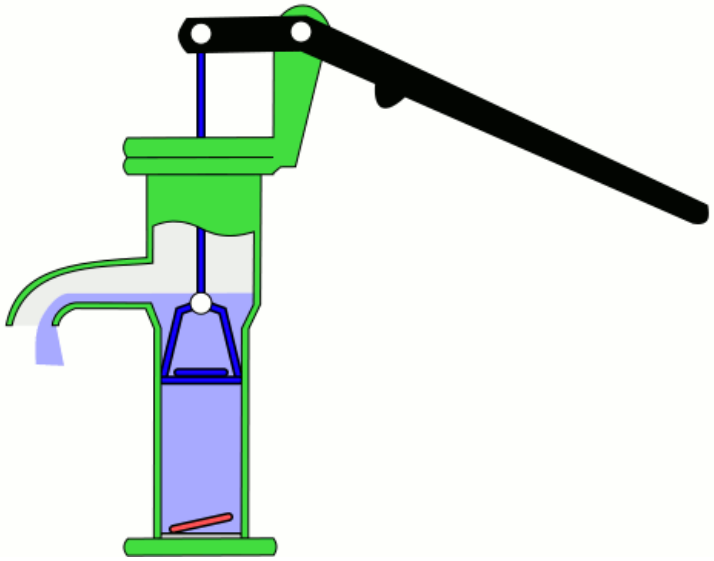
Heart

Reciprocating positive displacement pumps/compressors

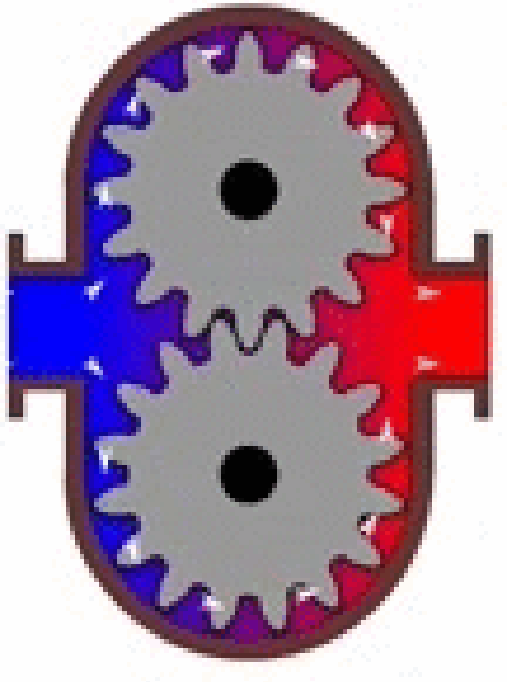


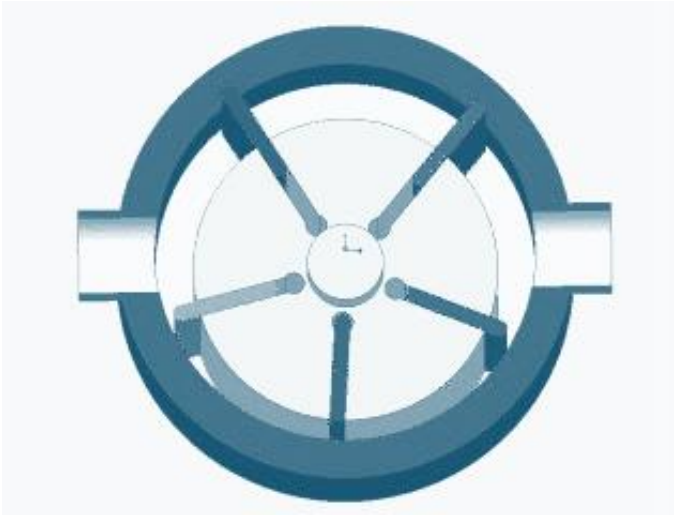


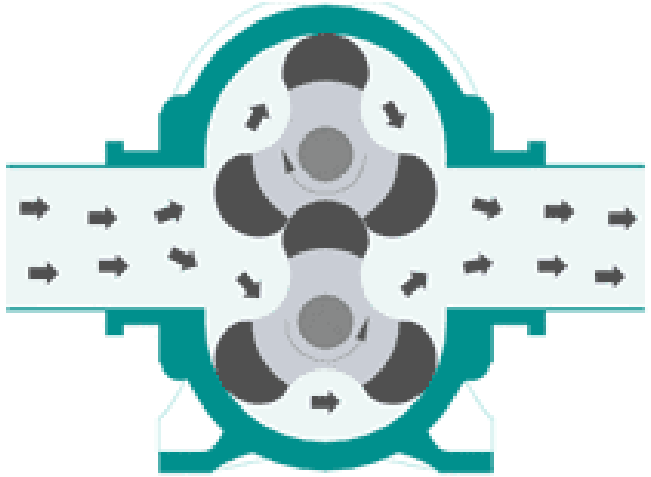


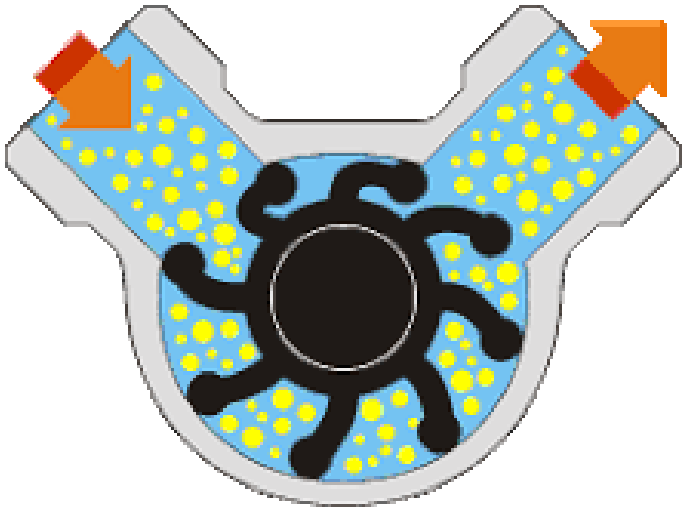


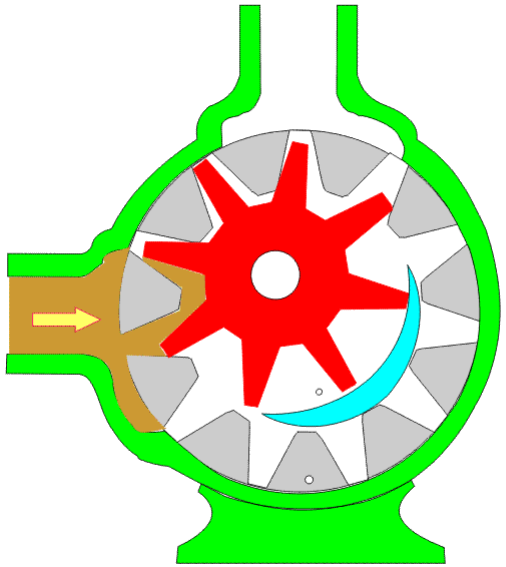
Rotary positive displacement pumps/compressors

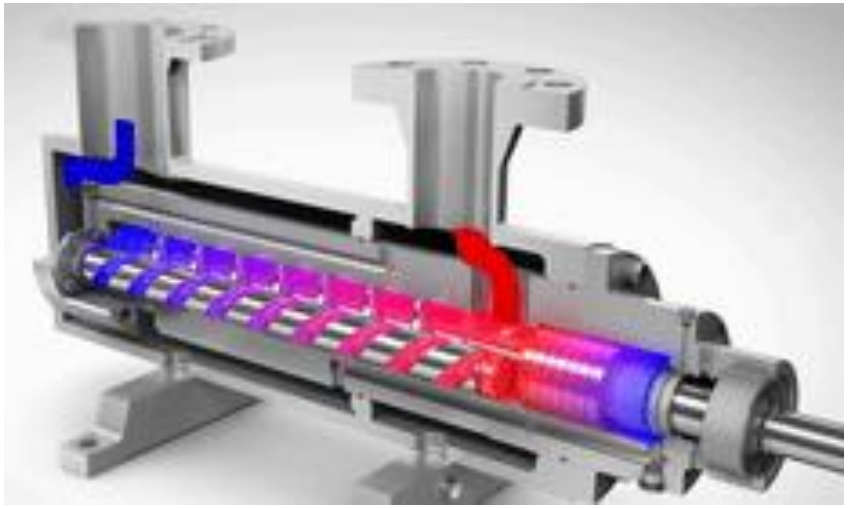




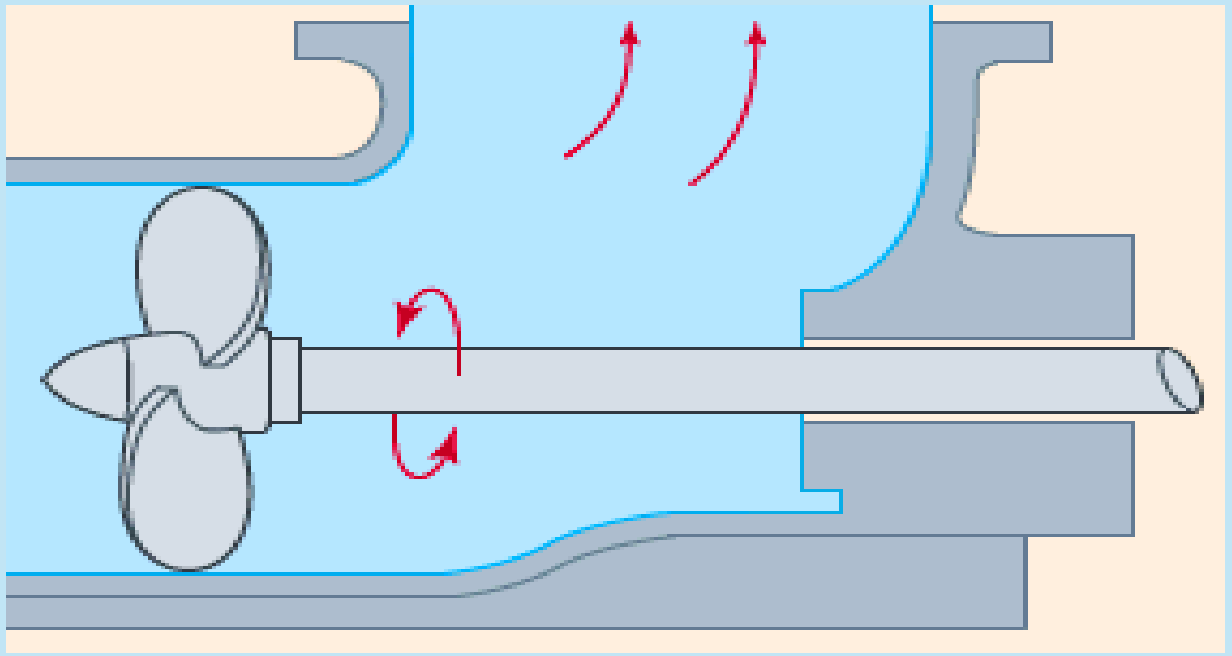


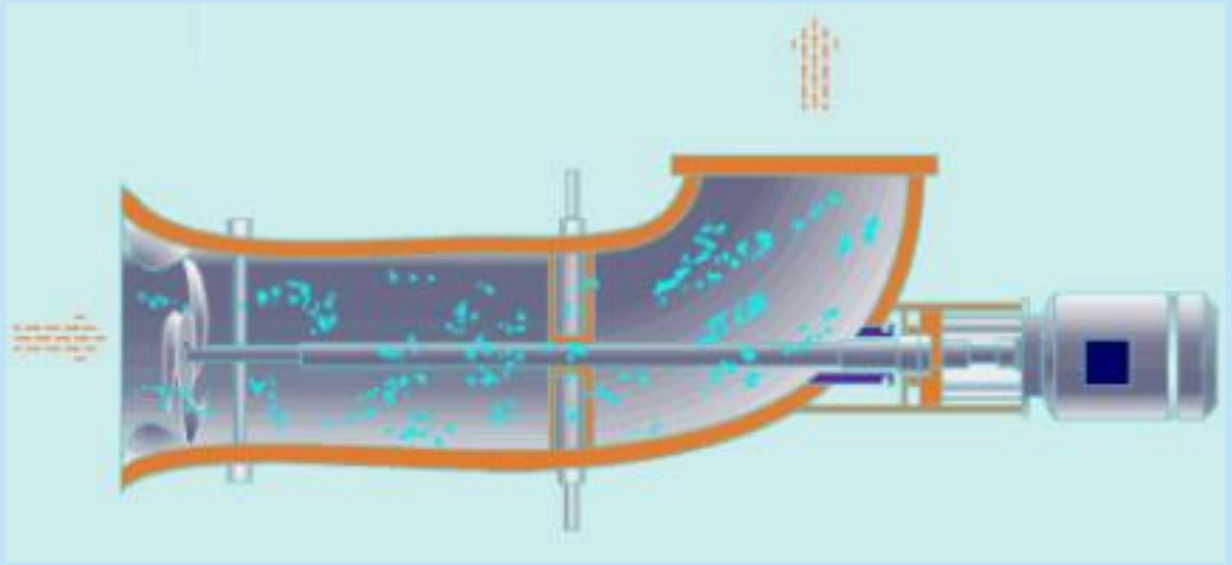


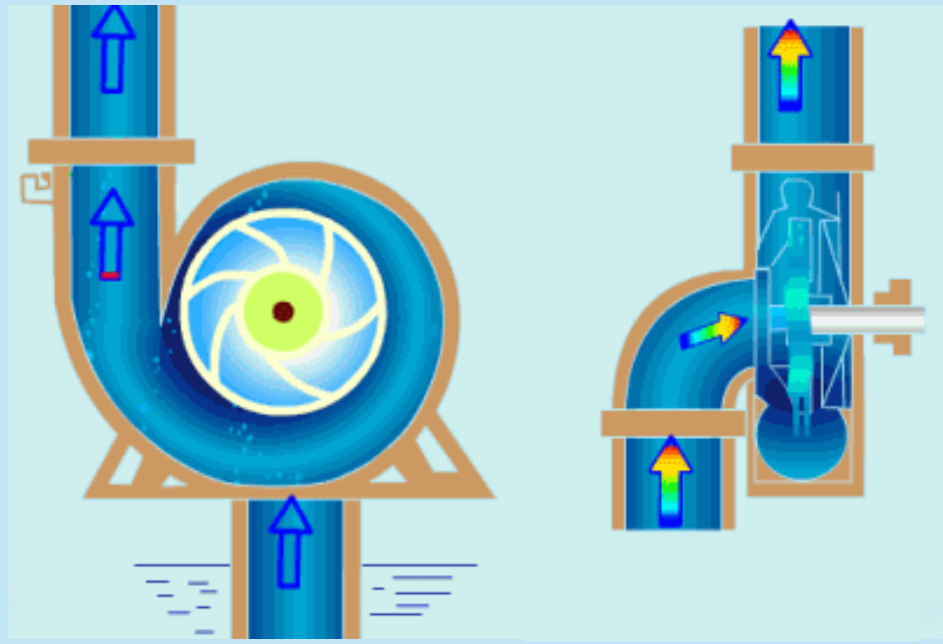


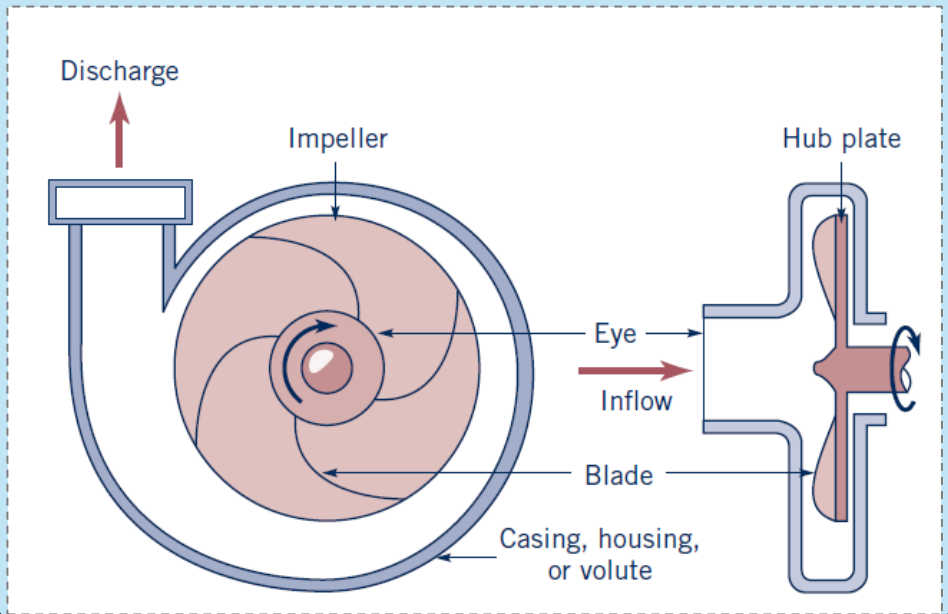


Rotodynamic pump/compressor

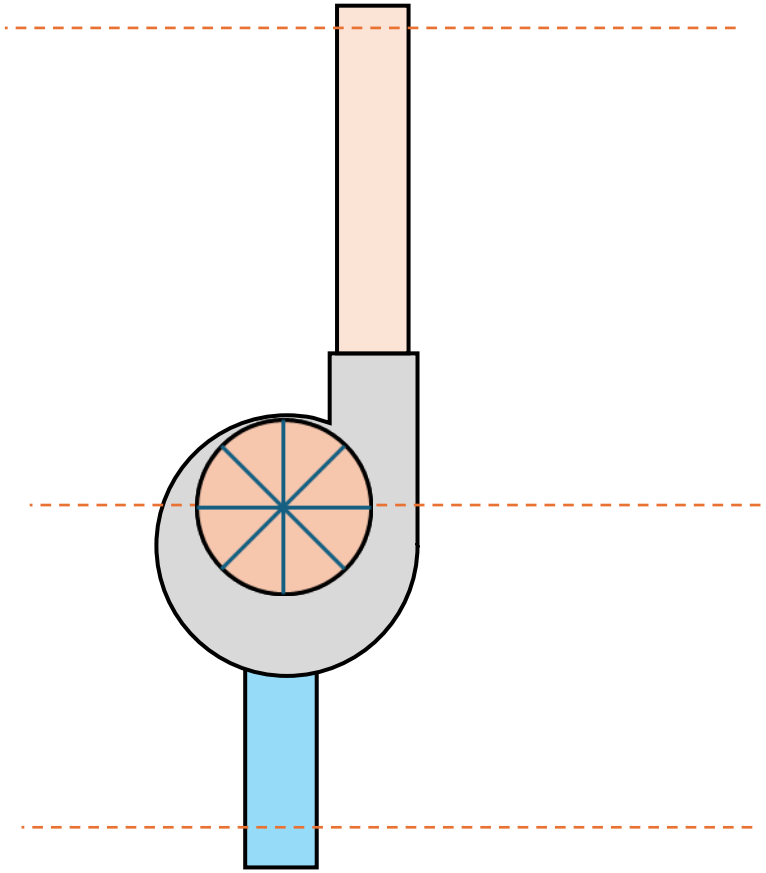




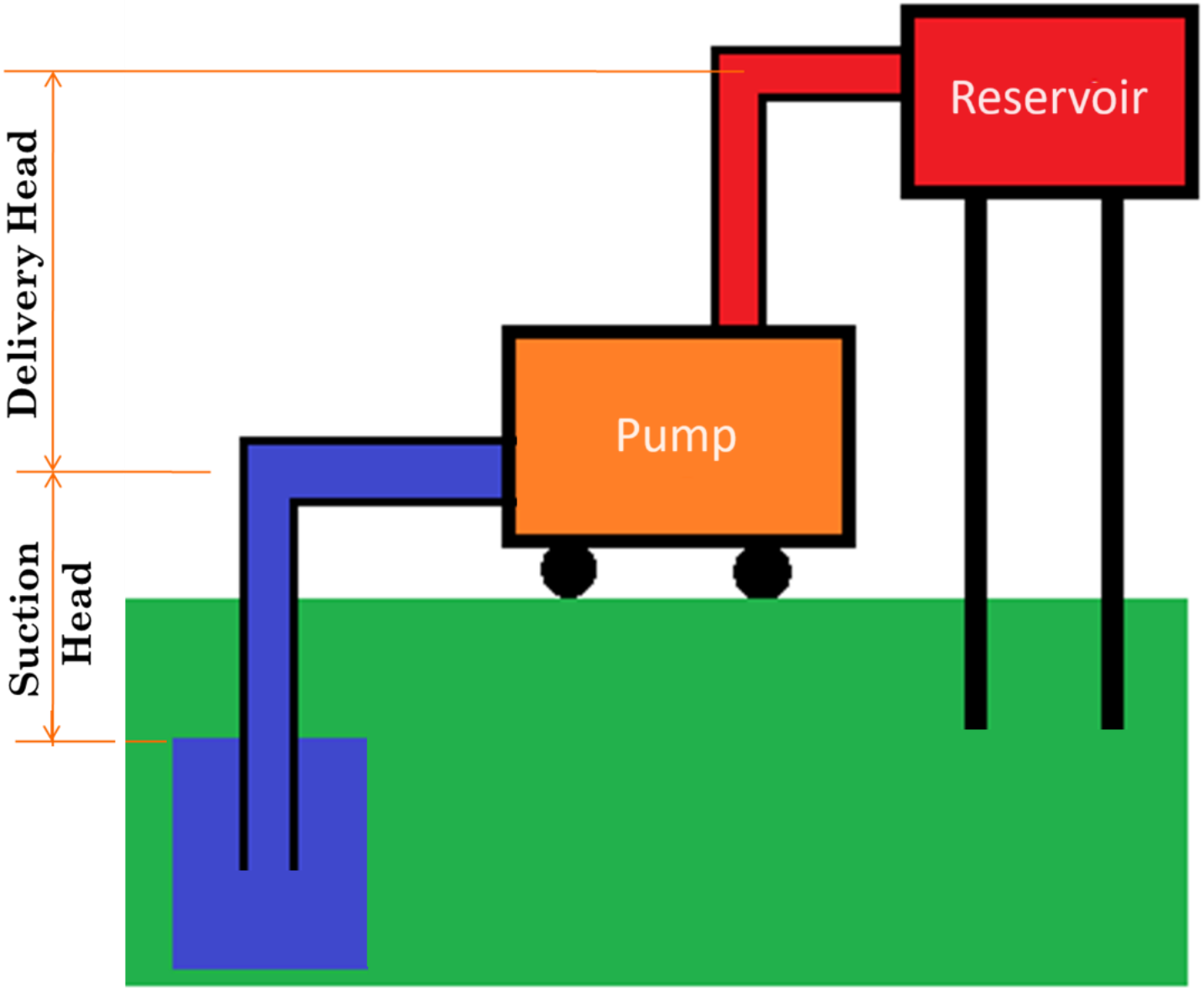




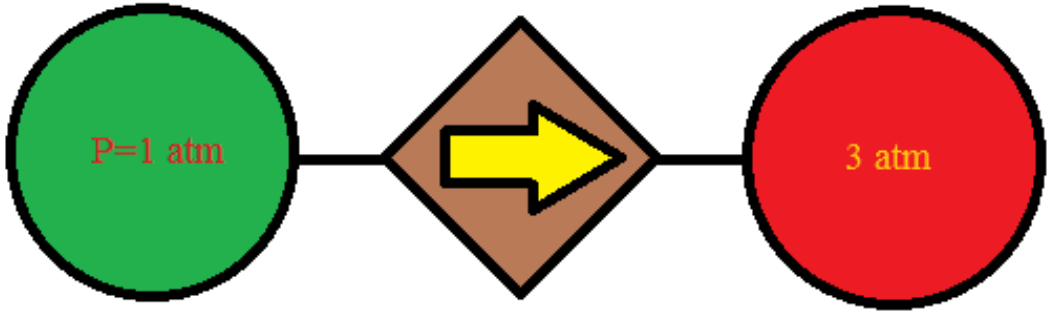
Pump operation heads



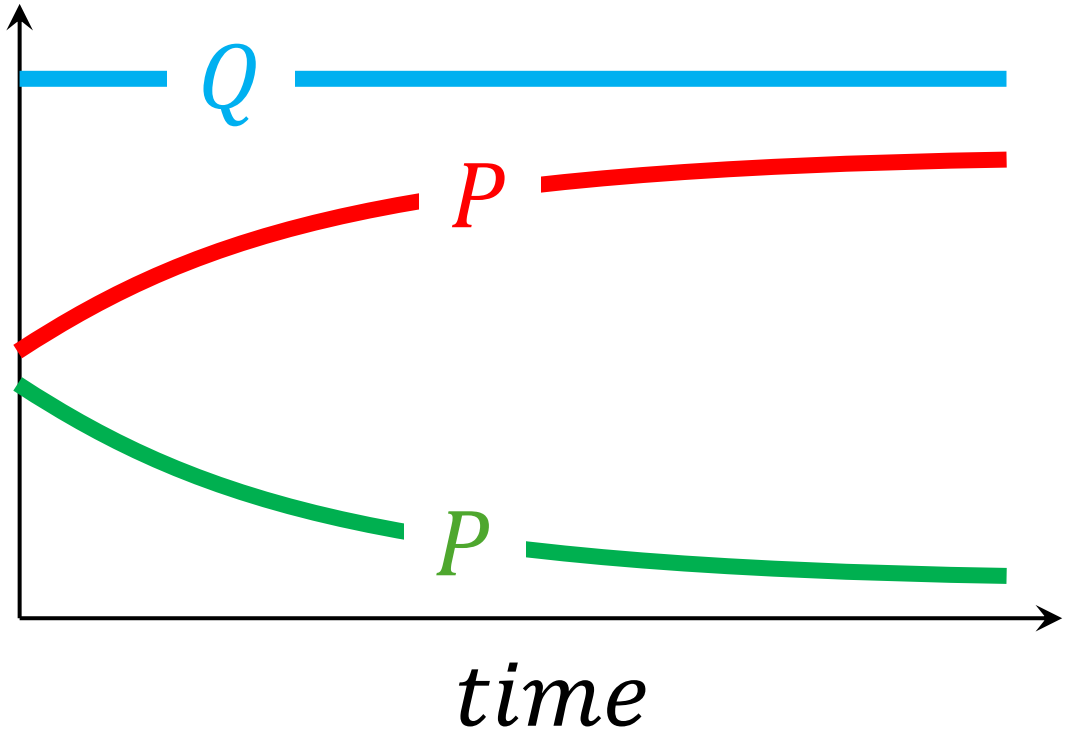
$$NPSH = \frac{P_{op}}{\rho g} - \frac{P_v}{\rho g} - H_f$$

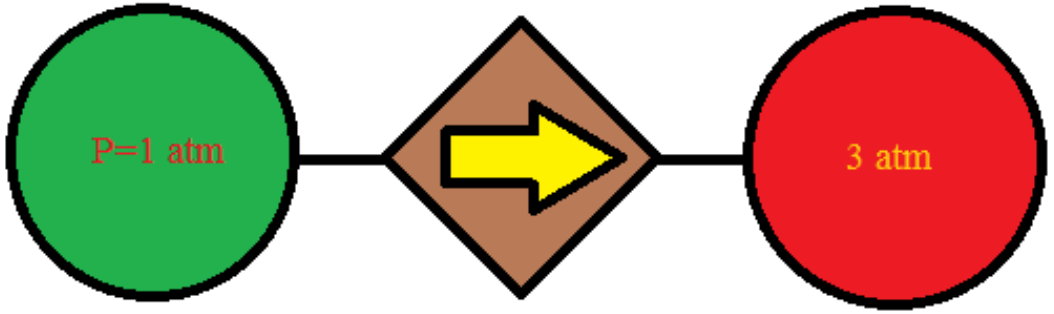


Rotodynamic and Positive Displacement Pump

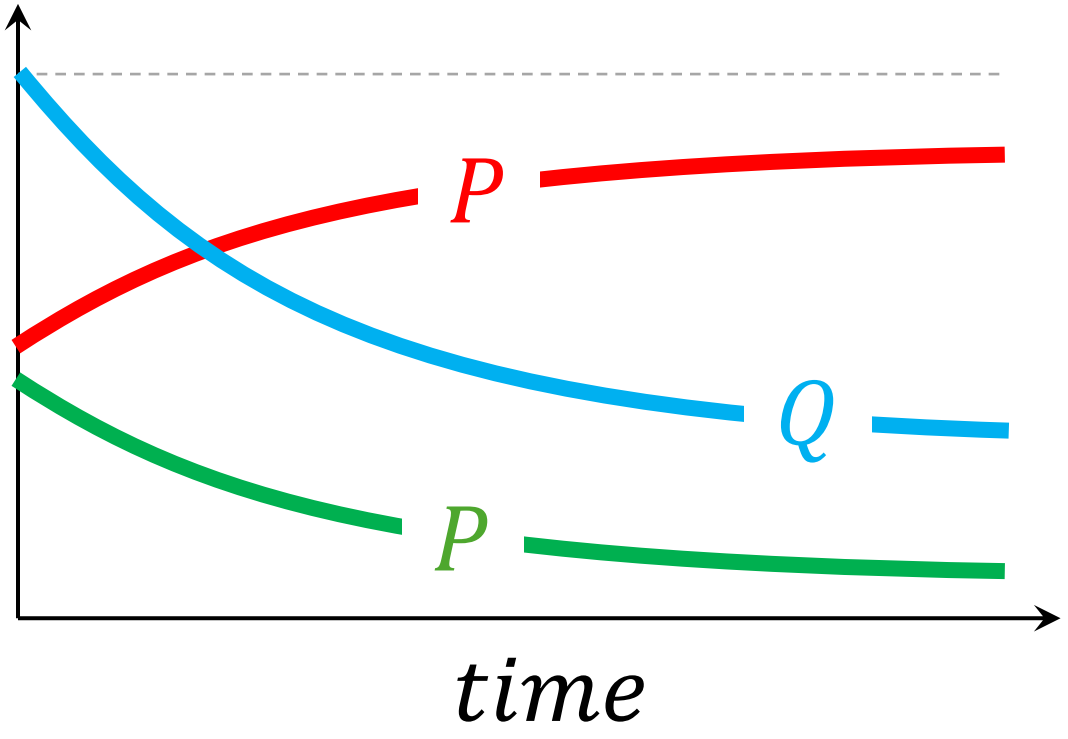


Positive displacement Pump



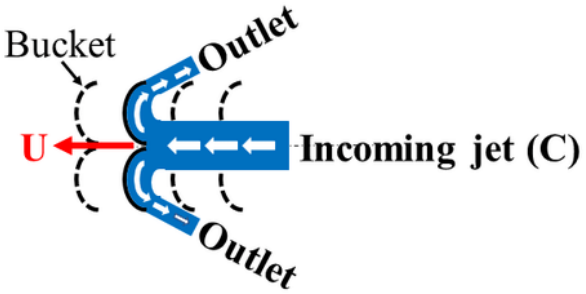


Rotodynamic Pump

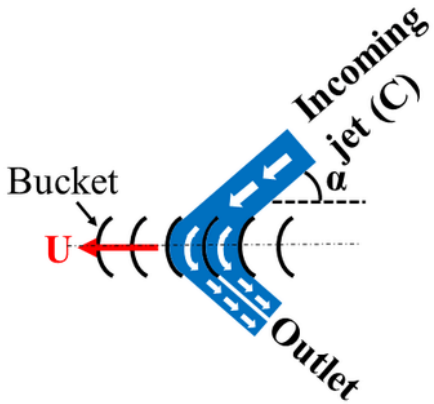


Turbo machines that gives “Work out”

- Turbines
  - Impulse
    - Pelton
    - Turgo
  - Reaction
    - Francis
    - Kaplan

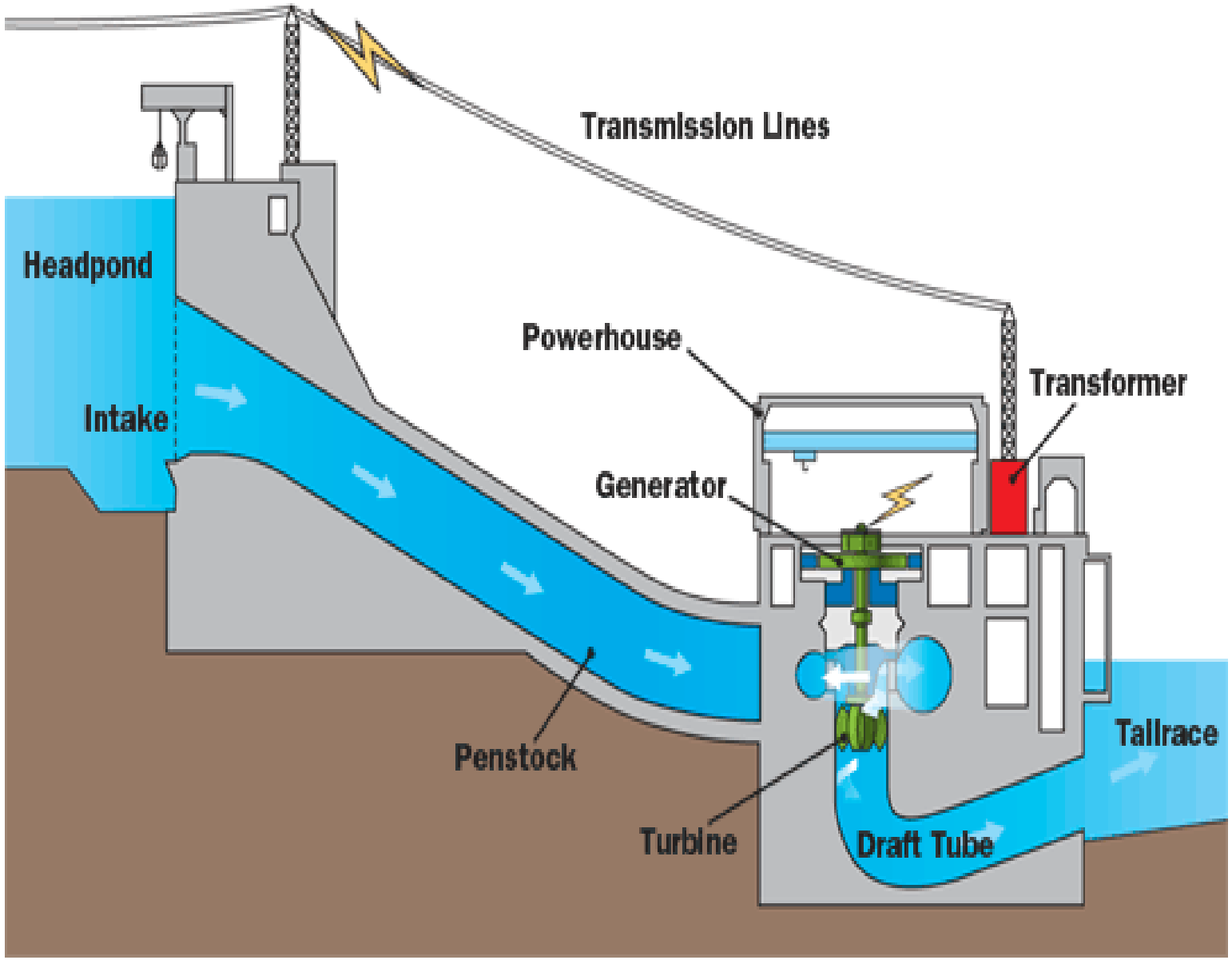


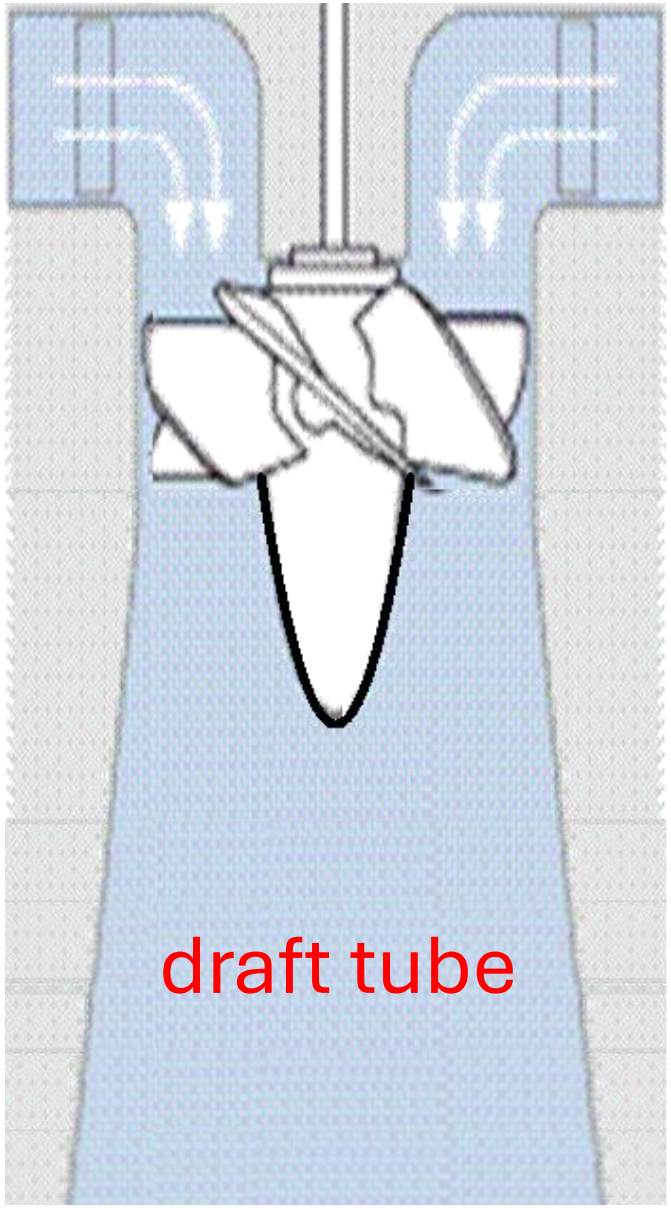
Pelton



Turgo

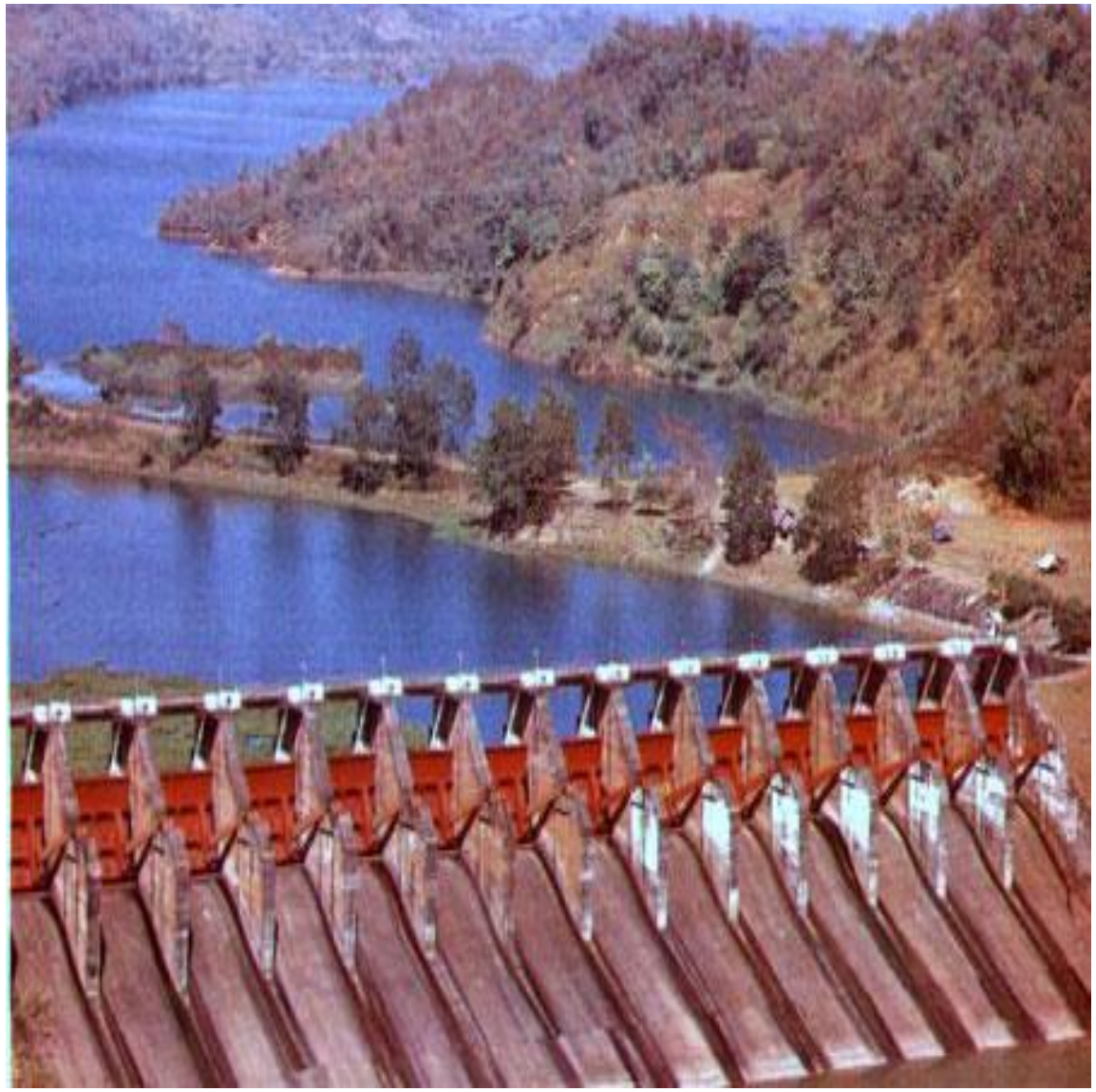
Hydro power plant (draft tube)





Kaptai Dam (Bangladesh)

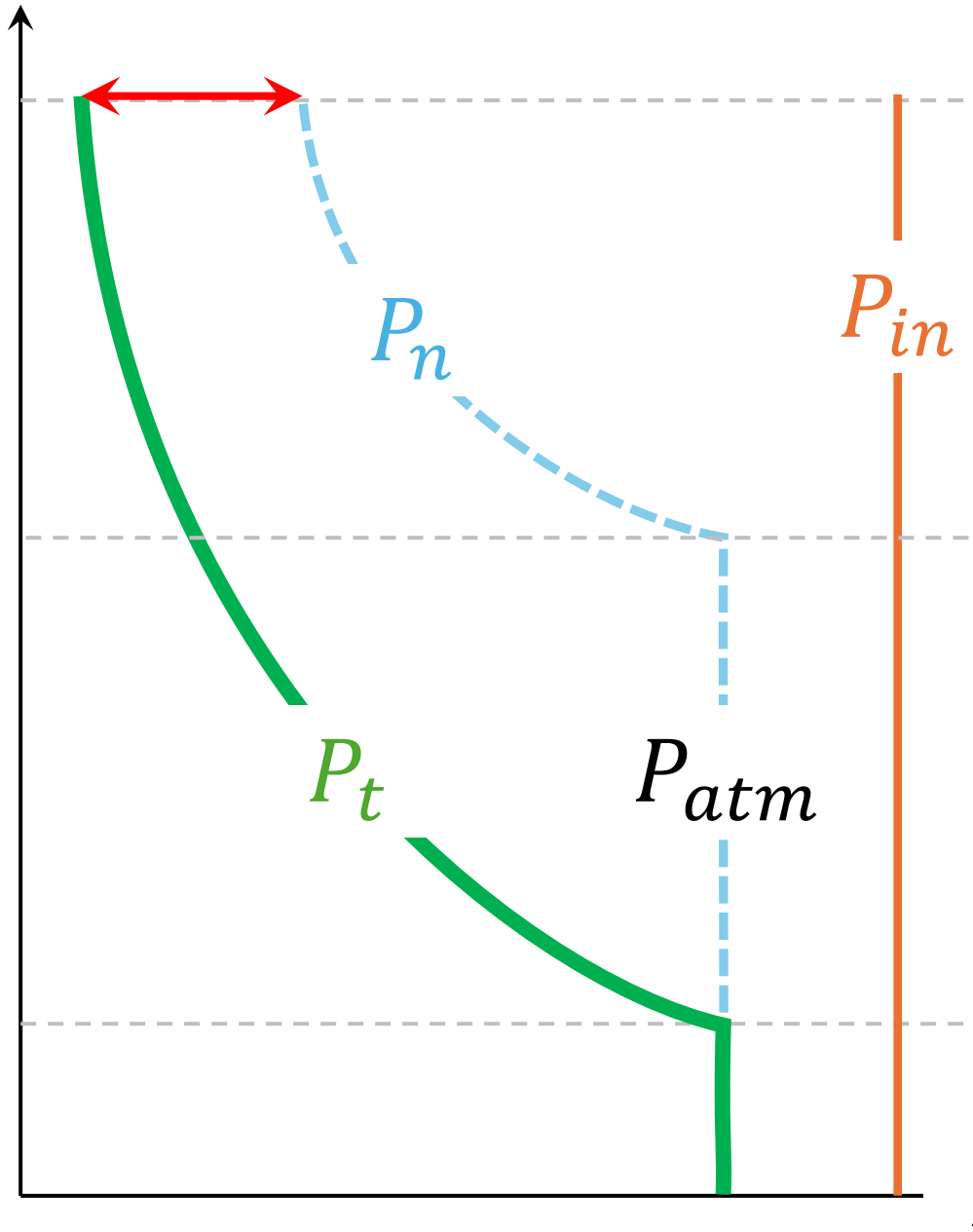
Capacity ~ 0.2 GW, Reservoir size ~ 300 sq. mi
Head ~ 15 m

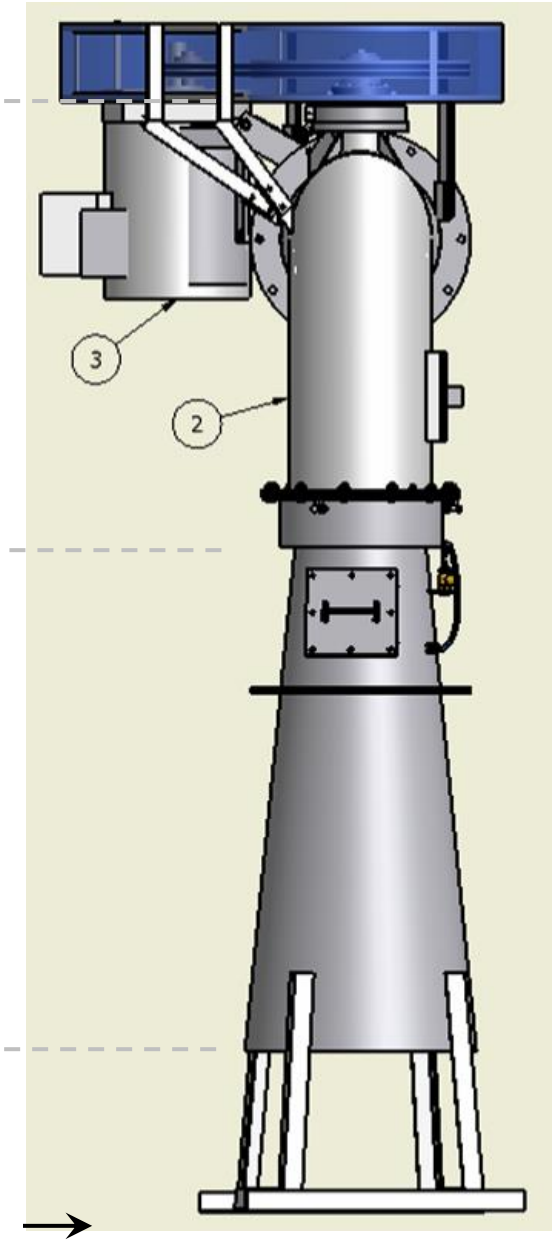


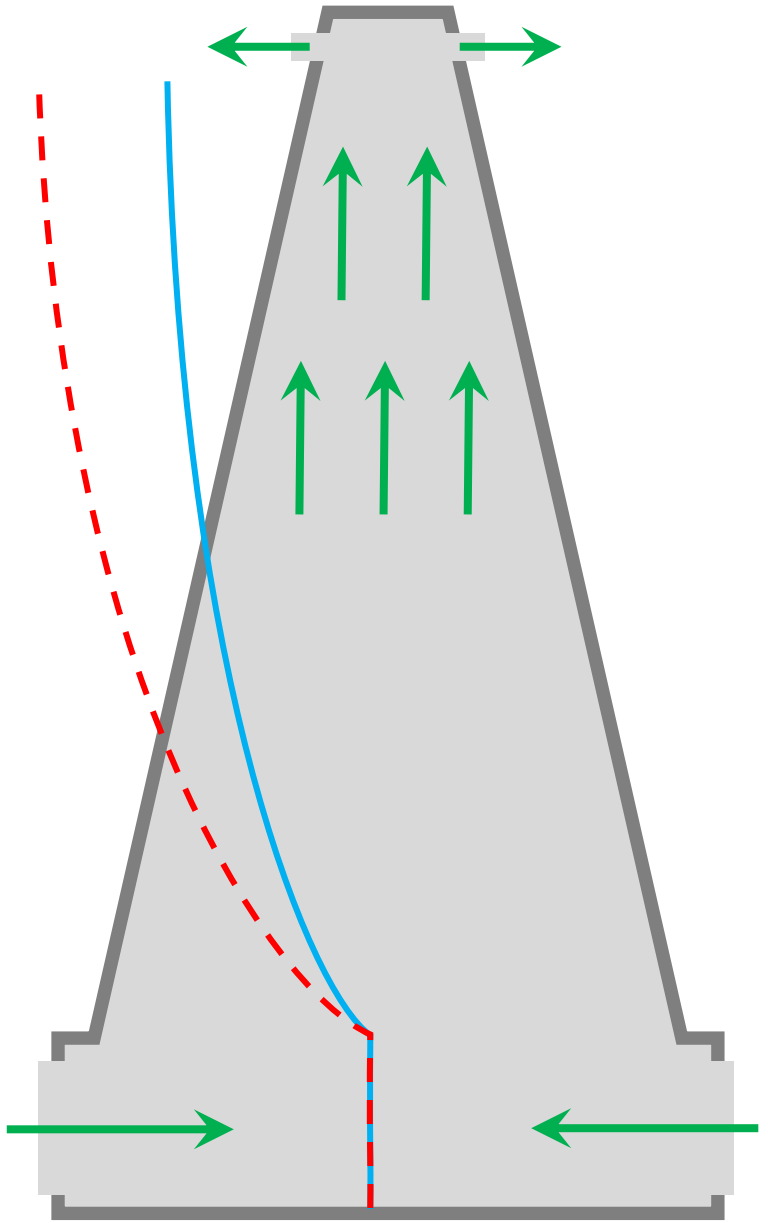
Hoover Dam (USA)

Capacity ~ 2 GW, Reservoir size ~ 250 sq. mi
Head ~ 100 m

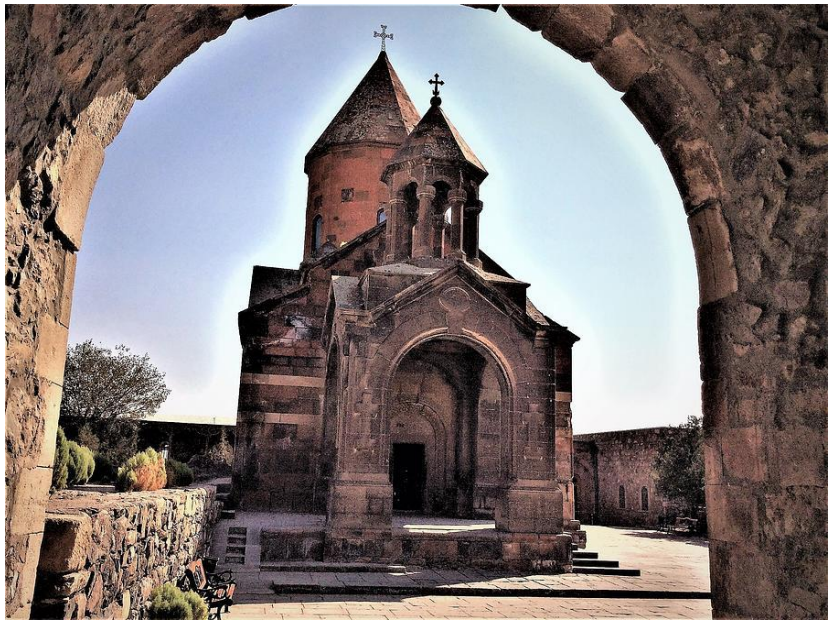
Draft tube: pressure recovery

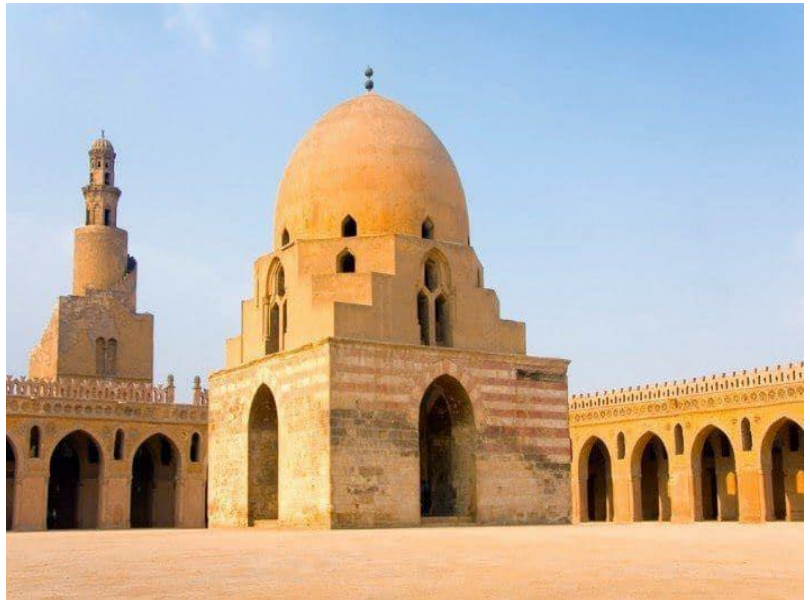




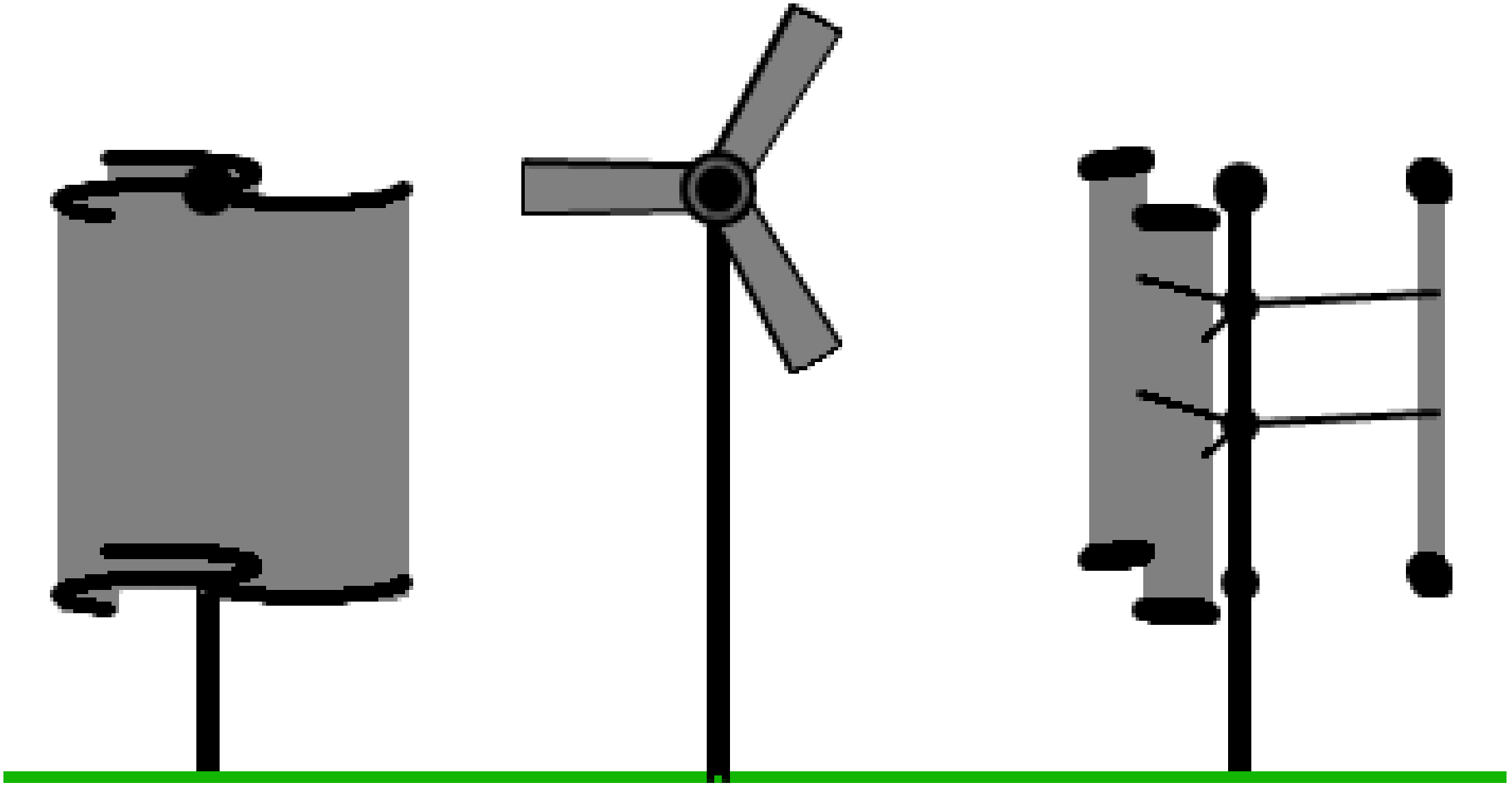


Ancient architectures

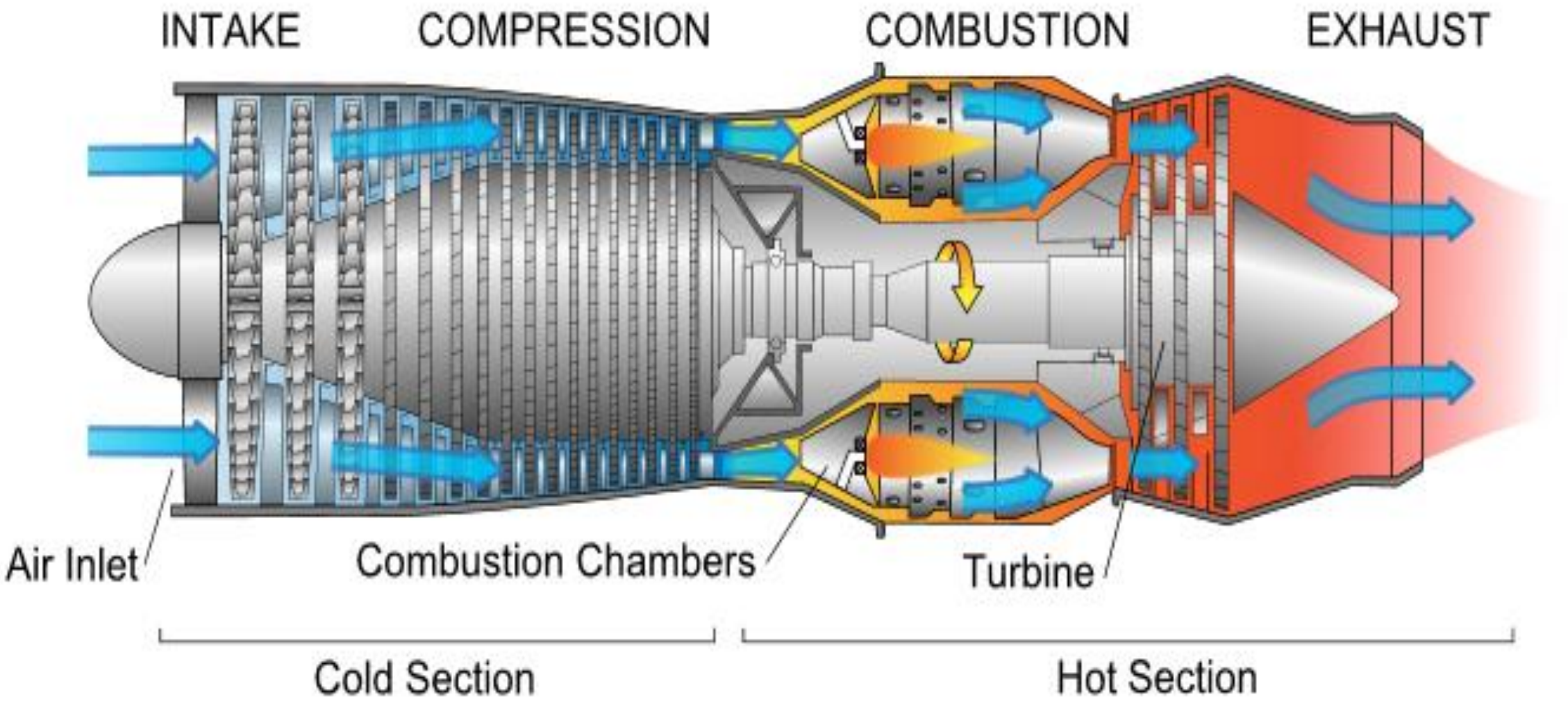




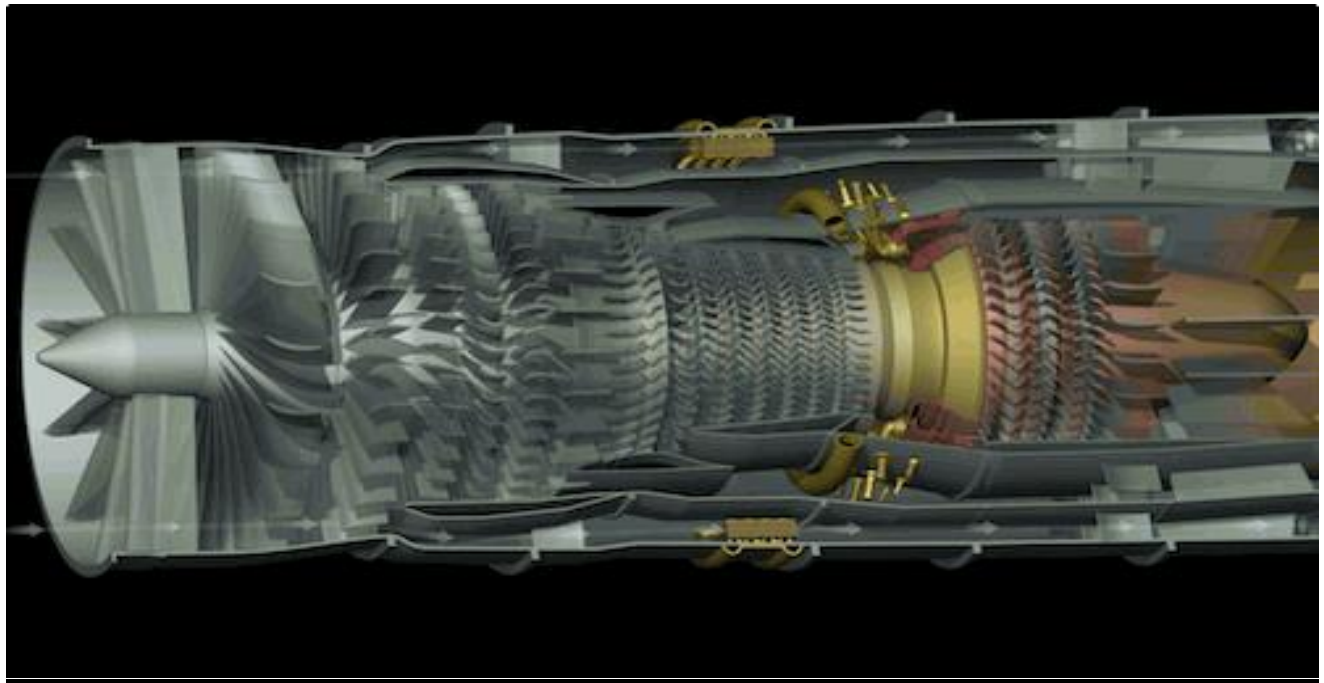
Wind turbines

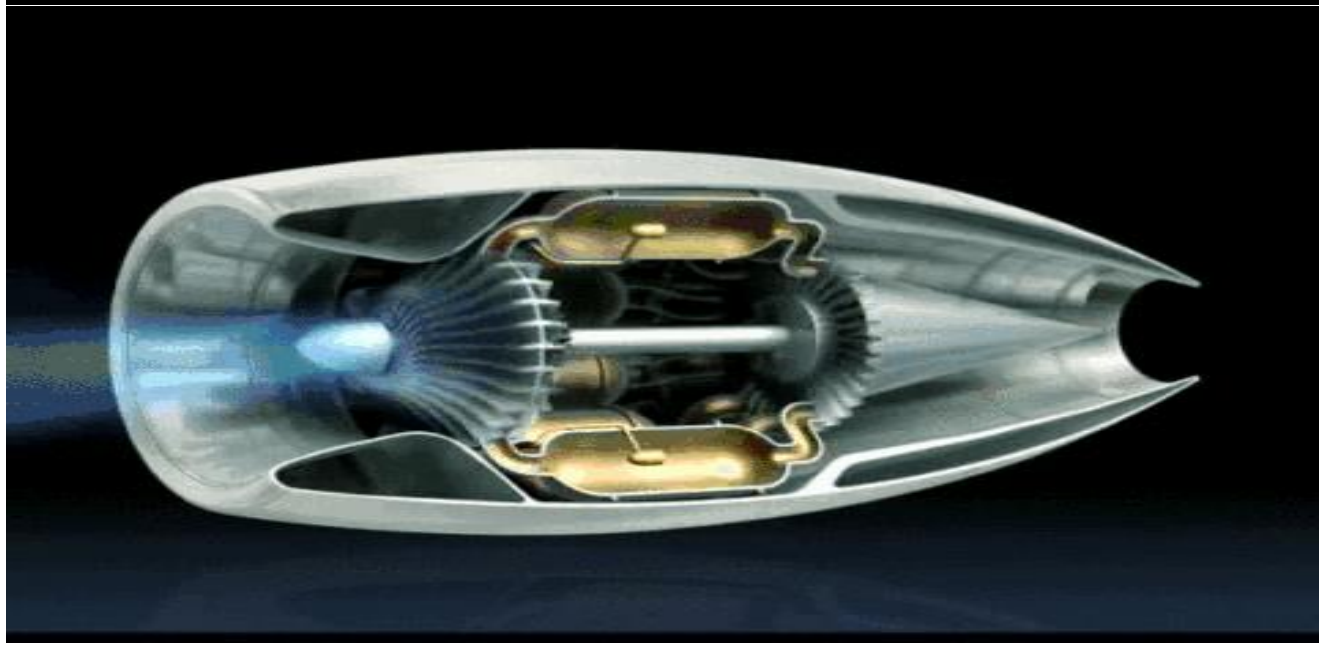


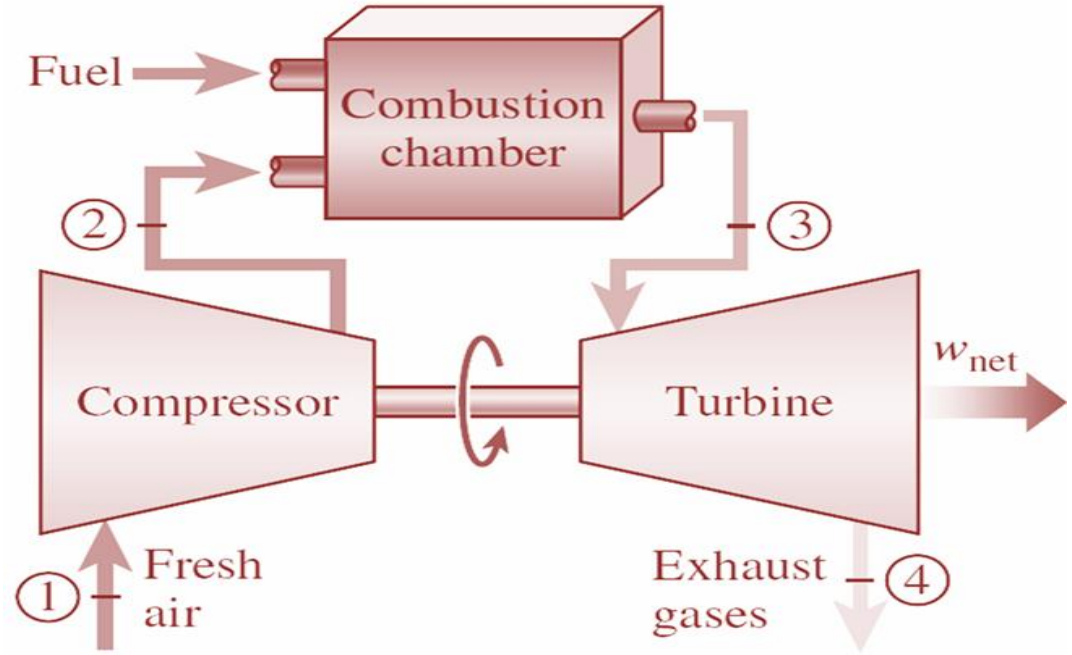
Gas Turbine

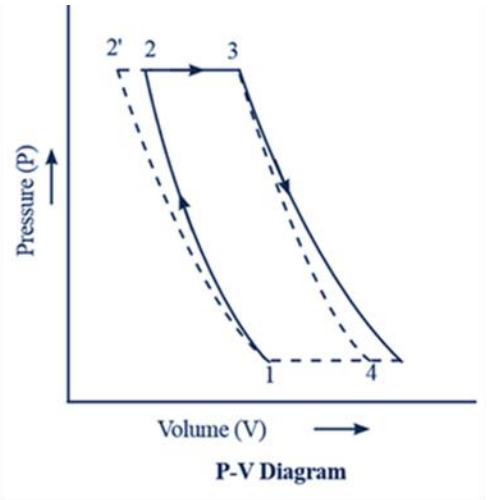

INTAKE
COMPRESSION
COMBUSTION
EXHAUST
Air Inlet
Combustion Chambers
Turbine
Cold Section
Hot Section

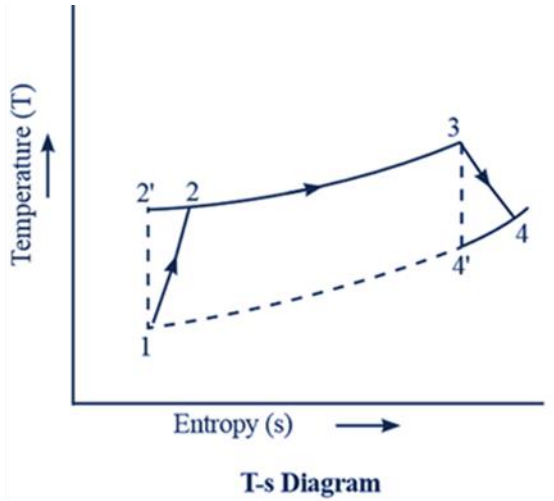
Gas power cycle



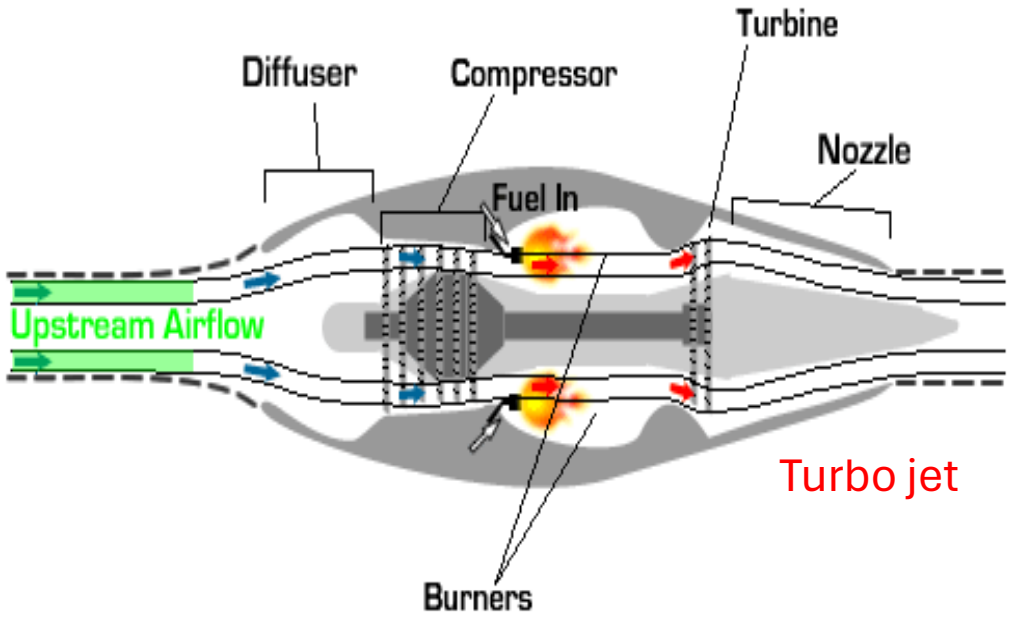




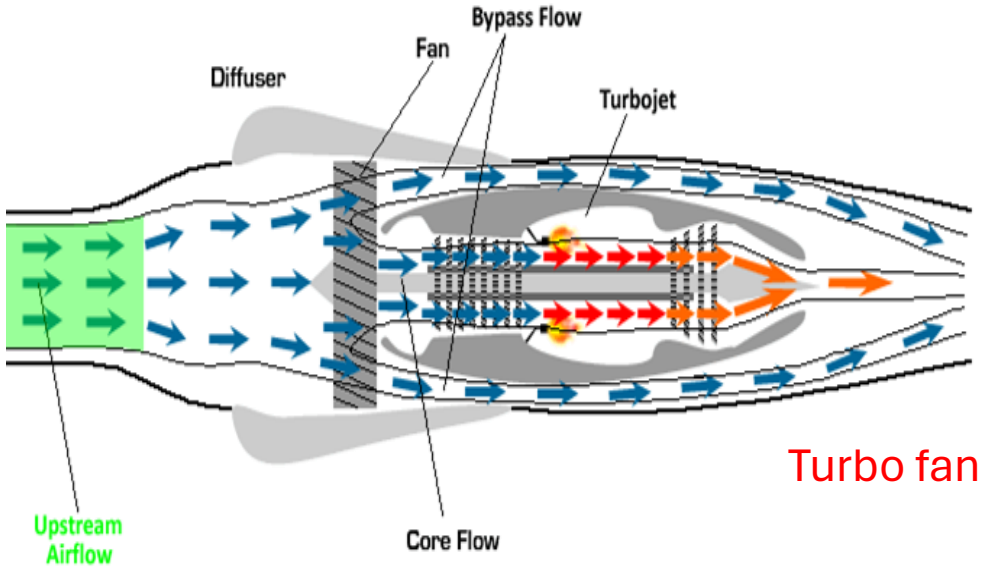




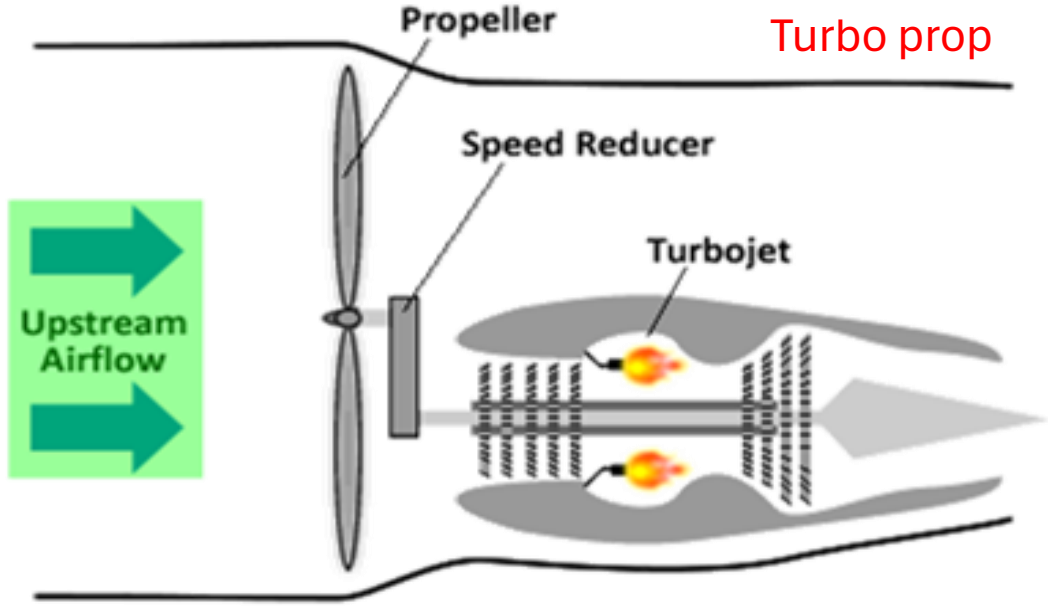
Jet Engines



Turbo jet



Turbo fan



Turbo prop

Other jet Engines

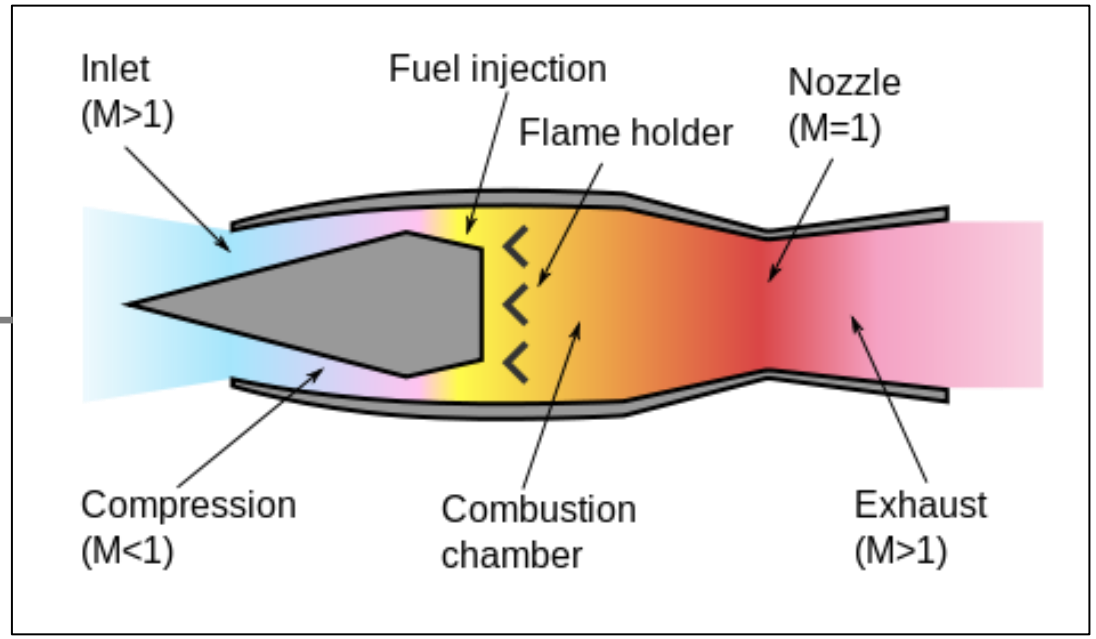
Ram Jet

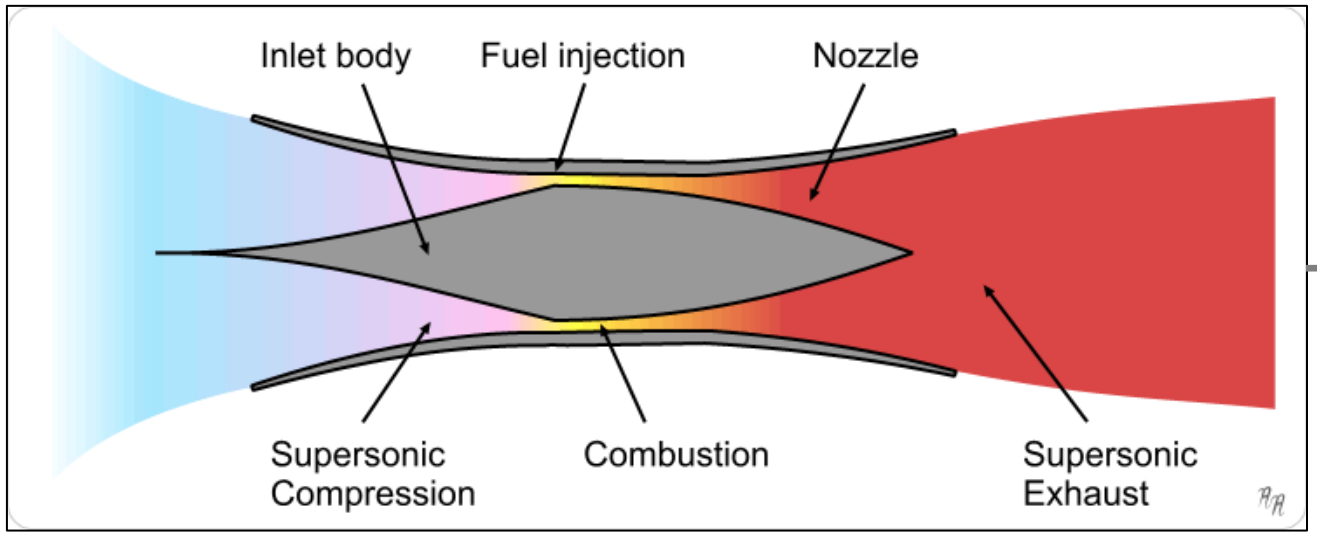
Between Mach 3 ~ 6

Flying ‘Stove Pipe’

Can’t move from standstill

Missile, Mortar etc





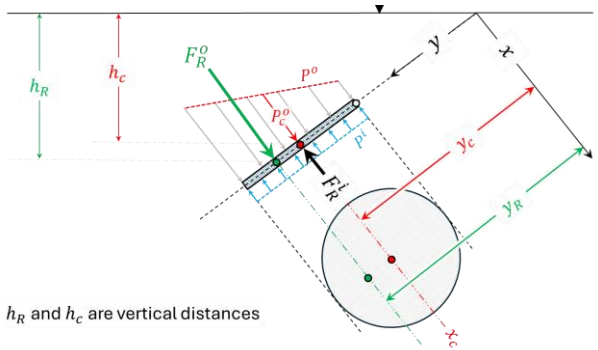
Scram Jet

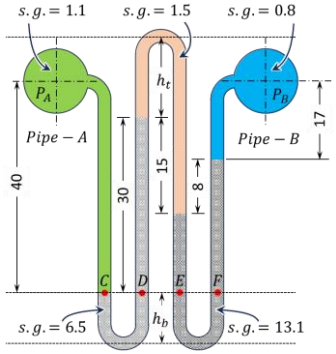
Between Mach 12 ~ 24

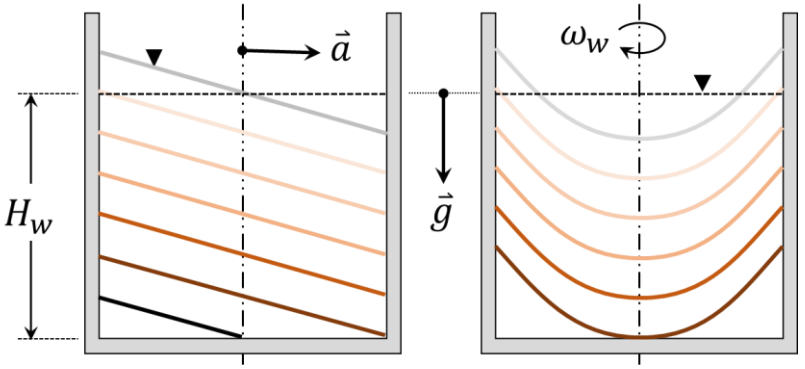
Still in progress

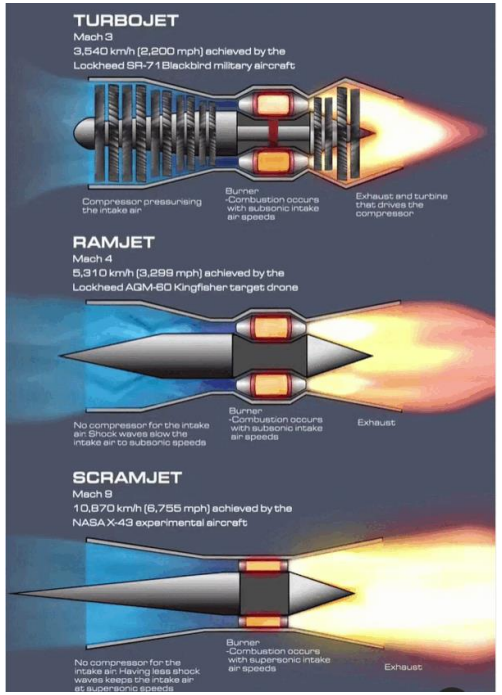
Very cost efficient

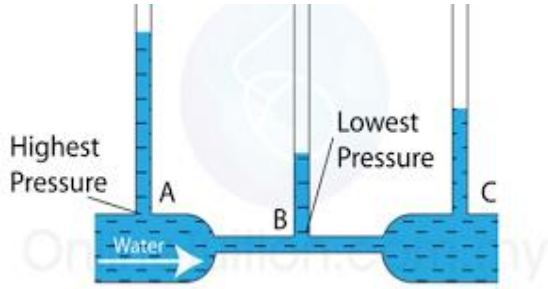
Revisiting fluid mechanics

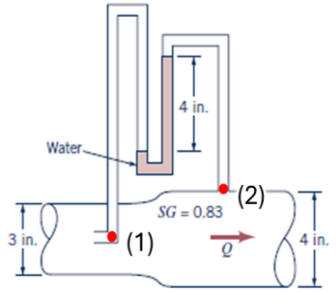


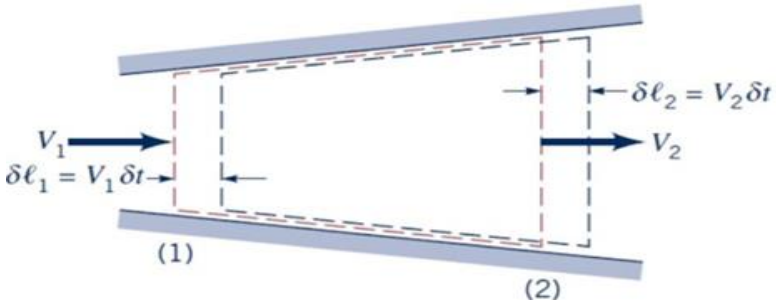


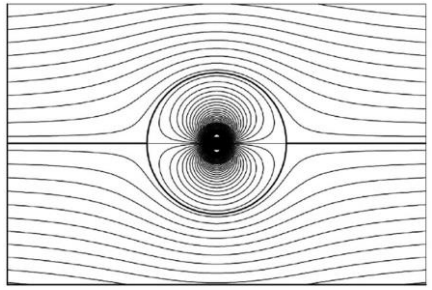


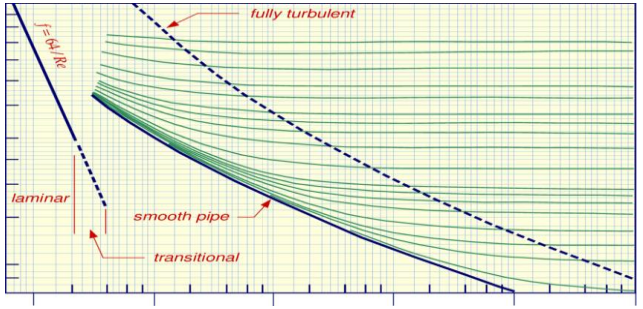


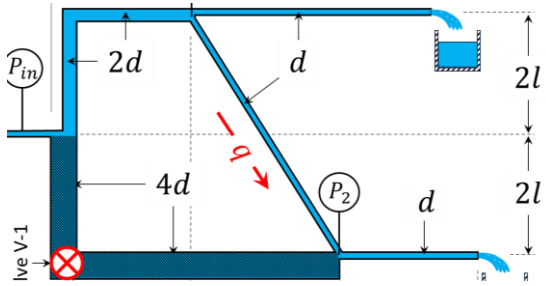


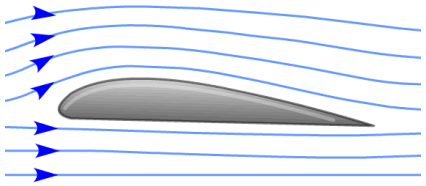


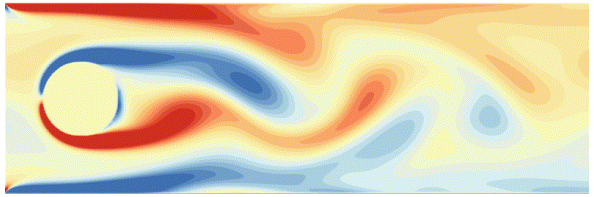


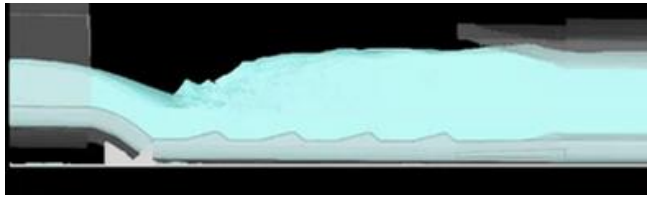


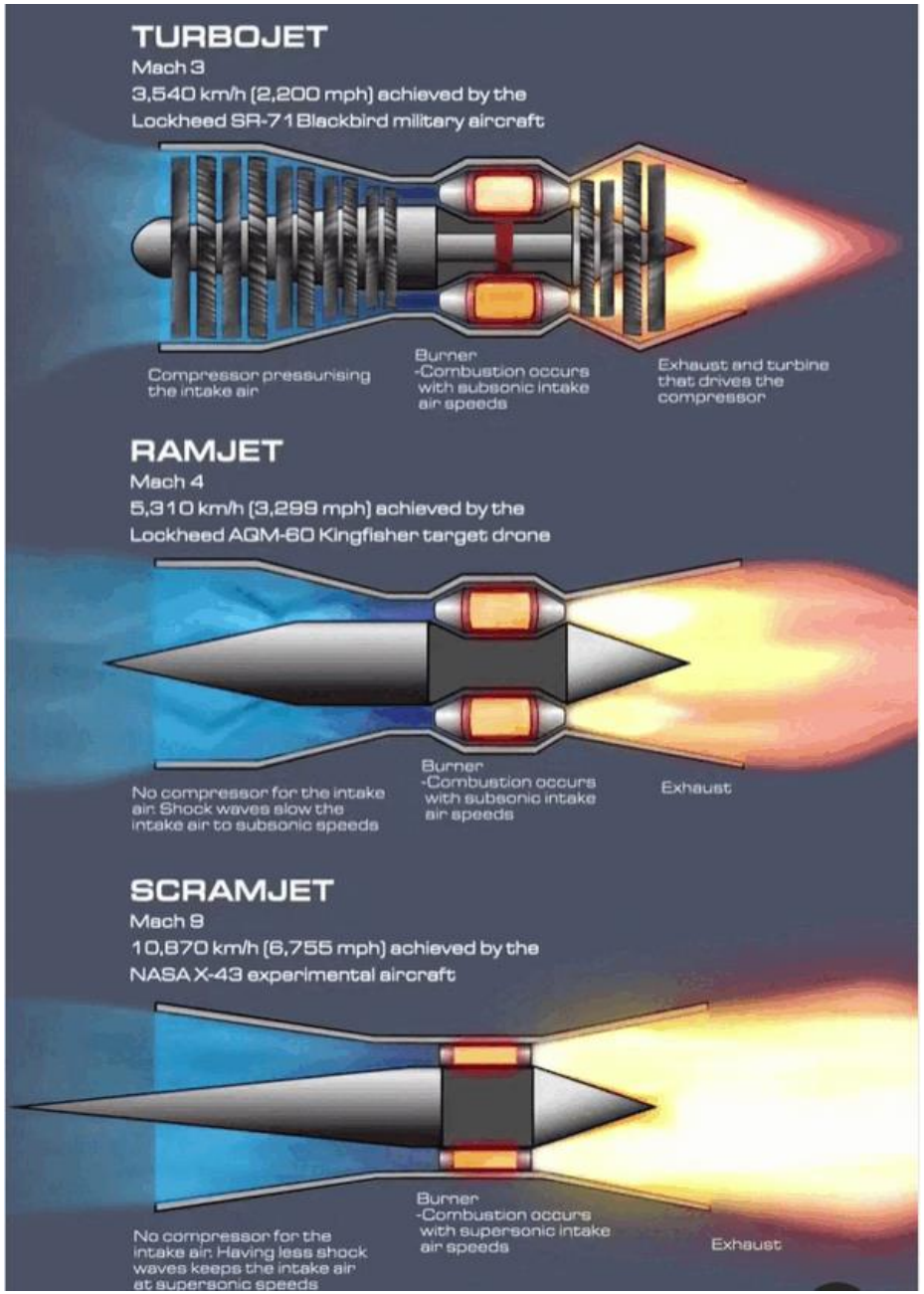











TURBOJET
Mach 3
3,540 km/h (2,200 mph) achieved by the
Lockheed SR-71 Blackbird military aircraft
Compressor pressurising the intake air
Burner
-Combustion occurs with subsonic intake air speeds
Exhaust and turbine that drives the compressor
RAMJET
Mach 4
5,310 km/h (3,299 mph) achieved by the
Lockheed AQM-60 Kingfisher target drone
No compressor for the intake air: Shock waves slow the intake air to subsonic speeds
Burner
-Combustion occurs with subsonic intake air speeds
Exhaust
SCRAMJET
Mach 9
10,870 km/h (6,755 mph) achieved by the
NASA X-43 experimental aircraft
No compressor for the intake air: Having less shock waves keeps the intake air at supersonic speeds
Burner
-Combustion occurs with supersonic intake air speeds
Exhaust