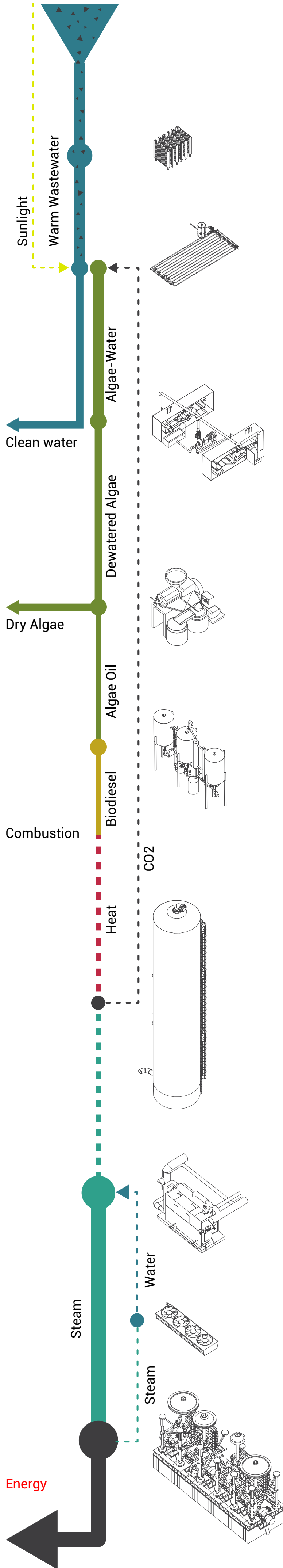


ECOLOGY OF TECHNOLOGIES



**Heat exchanger**  
Invented by: Ammon Johannes H (shell and tube type heat exchanger)  
Patent date: 1965  
Function: Set of equipment used for efficient transfer of heat from one medium to another, mostly without physical contact of the materials. The residual heat generated from the combustion chamber will be used for heating the supplied waste water from the water collection center.

**Photobioreactors**  
Originally developed by: Harold W. Milner  
First use: 1948  
Function: Used for algae cultivation. Photobioreactors float on sea level which help for mixing, cooling and achieving maximum sunlight. Tubes contain warm waste water (rich in nutrients) and CO2 for algae growth

**Belt filter**  
Invented by: Richard E. Engwall and John E. Krynski  
Patented: 1969  
Function: With the help of the gravity and density differences of algae and water, algae slurry is separated to algae and clean water. In order to achieve faster results, vacuums can be used.

**Screw press**  
Originally developed by: Hero of Alexandria (assumed, although it might be used earlier as well)  
First use: sometime during the 1st century (A.D.)  
Function: Uses compressive forces to extract oil from algae and to produce dry algae and algae oil. Dry algae can be used as a fertilizer in the agriculture industry.

**Transesterification**  
Process first introduced by: G. Chavan  
Introduction date: 1937 (as a patent)  
Function: Transesterification is a chemical process using an alcohol and an ester to produce another type of alcohol and another type of ester. The algal oil will be mixed with methanol to produce glycerol and biodiesel. Glycerol output can be used in several other sectors (i.e. pharmaceutical, food)

**Combustion chamber**  
First mentioned by: Marcus Vitruvius Pollio (not the chamber itself, but using some fuel at a designated place for producing heat)  
Date: 15 BC (mentioned in the book De architectura)  
Function: Used for the combustion of the fuel at a safe chamber to produce heat. The heat produced at the combustion chamber will be used by heat exchangers and boilers.

**Chimney**  
First use: Romans (used for bakeries) or Conisbrough Castle in South Yorkshire (assumed to be the first). Inventor not known.  
Date: 2nd Century BC (Romans) or 1185 AD (Conisbrough Castle)  
Function: Using the stack effect and pressure differences, the warm and mostly dangerous air is carried out. The air carried by the chimney will be subject to some processing before release for emission regulations and the CO2 will be collected to be used during the algae harvesting process.

**Boiler**  
First built by: John Blakey  
Date built: 1766  
Function: Boiler is a closed structure in which water (or some other fluid) can be heated. The idea is to use the heat generated at the combustion chamber to heat up the water to very high temperature for the production of steam.

**Condenser**  
Originally invented by: Samuel Hall  
Original patent date: 1838  
Function: A unit used for conversion of a substance from its gaseous state to liquid state. It would be very costly to supply fresh water to the boilers all the time for energy production and condensers are used to convert steam from steam turbines to water, which will be supplied back to the boilers.

**Steam turbine**  
Originally developed by: (disputed) Hero of Alexandria (with the toy size steam based machine called Aeolipile), Taqi ad-Din Muhammad ibn Ma'ruf (with the steam turbine description) and Charles Algernon Parsons (modern steam turbine)  
Development date: 1st century AD (Hero of Alexandria), 1551 (by Ibn Ma'ruf) and 1884 (by Parsons)  
Function: A device which converts thermal energy from high-pressure steam to mechanical energy. The actual sizing depends on the daily yield of biodiesel from the algae harvesting (the plan is to use two steam turbines with 0.6 MW output). Alternatively, the energy generation can be handled by diesel generators instead of steam turbines, which depends entirely on the daily working schedule of the power plant.

