

# 10 Turbines

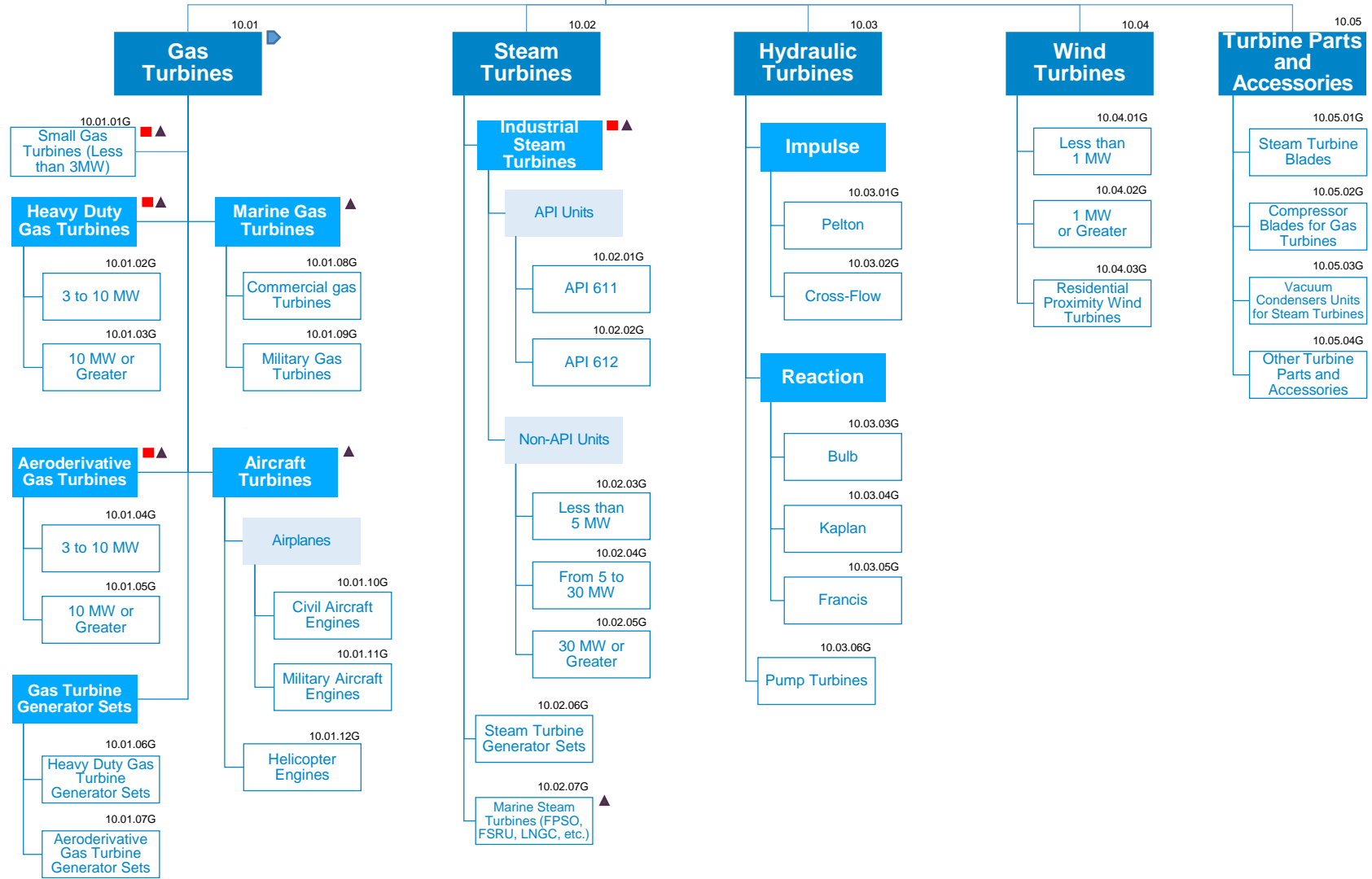
**API International Standards applicable to Categories**

API 616

**Drive Applications**

Generator Drive

Mechanical Drive



# Turbines

Turbines are mechanical devices that are used to extract energy from a fluid flow, converting it in work.

Turbines can be categorized as “mechanical drive”, when they use the rotation energy to run a compressor or a pump, or as “generator drive”, when they use such energy to run a power generator.

There are four main Families of turbines, classified based on the fluid that moves them, that are gas, steam, hydraulic and wind turbines.

Turbines have their most notable applications in the Power and Renewables industries (most of the electrical power in the world is generated by a turbine), and have relevant application also in Oil&Gas, Chemical and other industries.

## MAIN RATIONALES BEHIND THE STANDARD CATEGORIZATION

### Gas Turbines

- The difference between Heavy Duty and Aeroderivative gas turbines lies in the fact that Aeroderivative are lighter weight gas turbines, which derive from aviation turbines.
  - The 3 MW and 10 MW limits were inferred by looking at the product listings of relevant players.
- API 616 is the American Petroleum Institute standard for “Gas Turbines for the Petroleum, Chemical, and Gas Industry Services”.
- The “Generator Sets” node includes suppliers that sell the whole generator set as a package.
- Marine Gas Turbines and Aircraft Turbines nodes include turbines used for propulsion (and not, for example, generator sets on a ship, which should be listed under gas turbine generator sets).
- Marine gas turbines operate in a more corrosive atmosphere due to presence of sea salt in air and fuel and use of cheaper fuels, they are therefore differentiated from other turbines.
- Turbine maintenance could have been included in this group, as it is often offered by the manufacturer, but it has instead been listed under the “Maintenance, Modification and Operations Services” Group, as a form of coherence with other equipment (e.g. Pumps, Compressors, ...). This is valid for Gas as well as other types of turbines.
- Turbines for aircraft need to be particularly light, they are therefore not delivered by all players.
  - Military and civil turbines were further differentiated, for both aircrafts and ships, as they present different requirements in terms of speed, dimensions, reliability, ...
- Turboexpanders could have been included in this family (or with a dedicated family in this group), as they are essentially turbines through which a pressure gas is expanded. However, their producers are usually closer to Compressors producers, they were therefore included in that Group.

### Steam Turbines

- Steam Turbines for process (petroleum, chemical, and gas industry services) typically follow API standards, while non-API turbines are usually applied to the Power and Renewables industries.
- API 611 and 612 are standards by the American Petroleum Institute, both of them are applied to “Steam Turbines for Petroleum, Chemical, and Gas Industry Services”; 611 being for general-purpose (non critical service, with pressure, temperature and speed limits) and 612 for special-purpose.
- The MW limits for non-API turbines were derived from the classification of main players (Siemens, GE-Alstom Energy, ...).
- The “Generator Sets” category includes suppliers that sell the whole generator set as a package.
- In the last few years marine steam turbine engines have mostly been replaced by diesel engines, which tend to be more efficient.
  - However, there are still a few players delivering this product.
  - Marine Gas Turbines includes turbines used for propulsion (not, for example, generator sets on a ship, which are included under gas turbine generator sets).

### Hydraulic Turbines

- Hydraulic Turbines transfer the energy from a flowing fluid to a rotating shaft.
- Hydraulic turbines were differentiated by their design, which defines the competition. There are two broad families of hydraulic turbines, impulse turbines and reaction turbines.
  - The impulse turbine generally uses the velocity of the water to move the runner and discharges to atmospheric pressure. The most relevant categories among reaction turbines are:
    - Pelton and Cross-Flow.

- A reaction turbine develops power from the combined action of pressure and moving water. The runner is placed directly in the water stream flowing over the blades rather than striking each individually (e.g. propeller turbines are similar to the propeller of a ship). The most relevant categories among reaction turbines are:
  - Bulb, Kaplan and Kelvin.
- Other types of hydraulic turbines exist, but they have not been included in specific categories due to a lesser relevance in the market.
- Pump-Turbines are a particular type of turbines which are able to revert the flow and work as a pump when needed. They are manufactured by specific players.

### Wind Turbines

- Wind turbines are considered to be all used for power generation purposes (generator drive). The power cut was taken by looking at the classification the main players use and products they are able to deliver.
  - 1 MW seems to be an appropriate cut to differentiate the competition. The largest wind turbines currently installed go up to ~8 MW.

### Turbine Parts and Accessories

- Turbine parts include both parts and spare parts, while accessories include all minor accessories for turbines that are not covered by other categories (e.g. consoles, specific air filters for gas turbines, etc.).