LNG is produced from natural gas in the liquefacation process. Liquefacation or condensation is a phenomenon that changes the aggregate state, when a substance passes from the gas phase into the liquid phase. This can take place under certain pressures and at a temperature below the critical temperature of the surroundings. Condensation is connected with reducing the distance among the molecules of a given substance. The drop in temperature makes the molecules move slower. The forces acting among them increase until they reach their new state of equilibrium. Heat energy is given out in this process. The liquefacation process takes place in a different manner when the gas contains impurities.

The main component of natural gas is methane. Apart from methane, it also contains ethane and propane as well as heavier hydrocarbons such as nitrogen, oxygen, carbon dioxide and sulphur. During the liquefacation process, natural gas has to be purified mainly from water and carbon dioxide in order to prevent particle matter forming when the gas is cooled to a temperature of approx. -160°C. In effect, LNG is a very pure gas – comprised of 95% methane, and only 5% of other components.

There are three basic liquefaction methods*:

1. Classic cascade cycle. The natural gas purified of carbon dioxide and water is passed under appropriate pressure through the facility and is cooled in three cooling cycles, in which the cooling agents are propane, ethane and methane. Propane from the first cycle is simultaneously used to liquefy ethane from the second cycle, whereas ethane from the second cycle is used to cool the methane in the third cycle. An advantage of this method is that it is a relatively energy saving process. A disadvantage is the large amount of facilities necessary for the process to take place, as well as the large quantities of pure ethane propane needed.
2. The cascade cycle with a mixed cooling factor. This is a modification of the classic cascade system with the use of only one compressor and one cooling agent constituting a mixture of hydrocarbons. Natural gas is firstly cooled with the use of the propane cooling cycle, and then cooled with the mixture of hydrocarbons. This method is a little more energy consuming than the classic cascade system, however, its advantage is the smaller number of facilities necessary to carry out the process. Due to the lower operating costs, different variants of this method are applied more frequently than the classic cascade system.
3. Decompression cycle with the use of a turboexpander. The gas liquefacation facilities with the use of the method based on the decompression cycle work in a similar way to Joule’s and Thompson’s classic method and facilities producing liquid oxygen and nitrogen with the use of low-temperature air fractioning. In this process, a portion of the gas is decompressed in a machine called a turboexpander, and then cooled to a very low temperature. The cooled gas is then used to liquefy another portion of gas flowing through the facility. This method is relatively simple and does not require large investment outlays. However, it is characterised by a large consumption of energy necessary to compress the gas. Due to this, this method is used in locations where the energy required to compress the gas is cheap. It is most recommended in case of small gas liquefacation facilities for covering peak demands.

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*Source: Jacek Molenda “Gaz ziemny. Paliwo i surowiec." [Natural gas. Fuel and Raw Material], Wydawnictwo Naukowo-Techniczne, Warsaw 1996.