

# Cryogenic Engineering

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## Chapter 1.

### INTRODUCTION TO CRYOGENIC SYSTEMS

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# 1.1 Introduction

CRYOGENIC=CRYO+GENE

Ice

Generation

CRYOGENICS

REFRIGERATION

-150°C  
(123K)

-40°C  
(233K)

25°C

## 1.2 Liquid Nitrogen

- **Liquid nitrogen**



## 1.2 Liquid Nitrogen

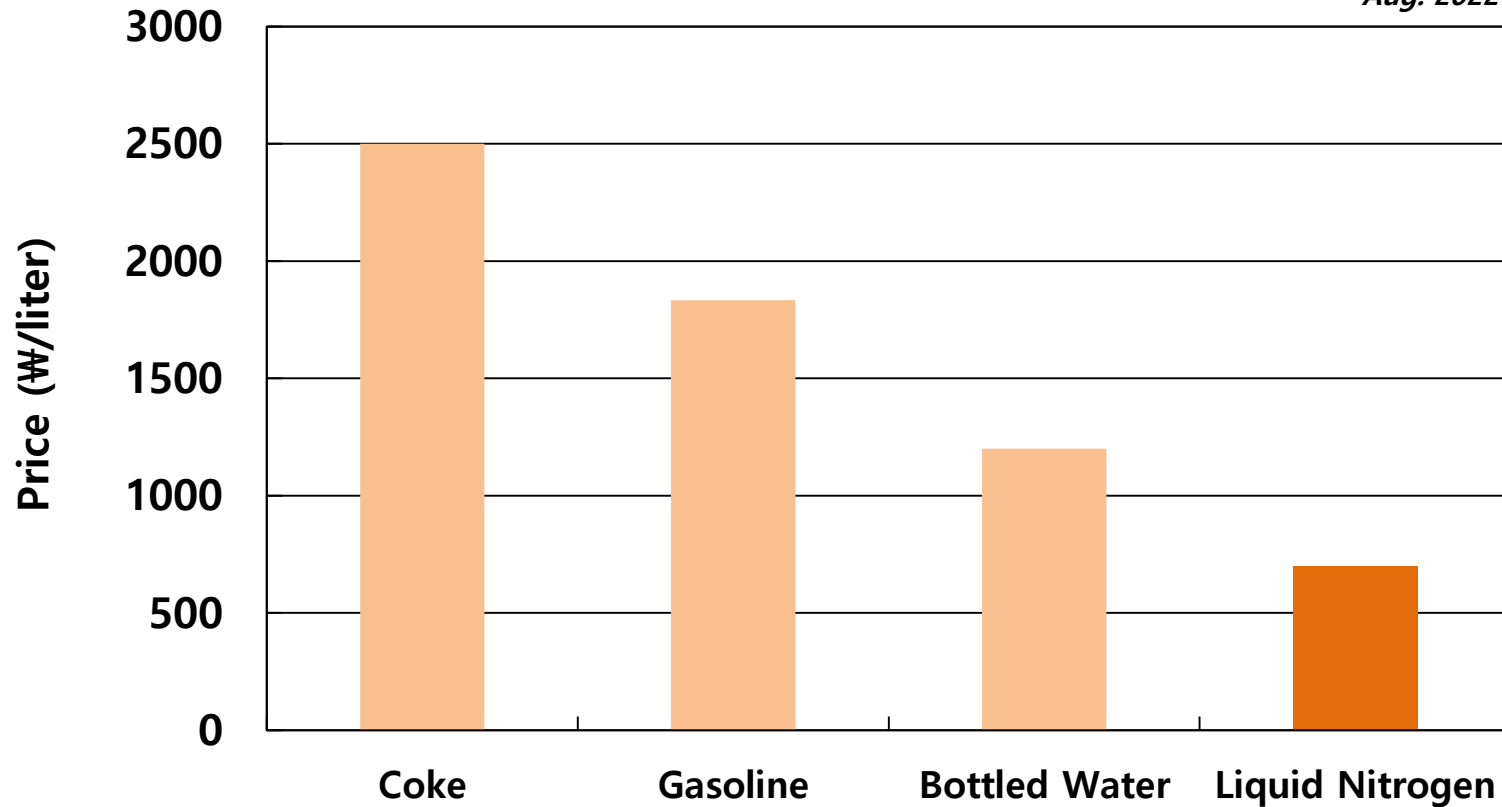
- How cold is it? (Video 03:30)

Need a hammer? Take a banana :-)

# 1.2 Liquid Nitrogen

- Price comparison

Aug. 2022



## 1.2 Liquid Nitrogen

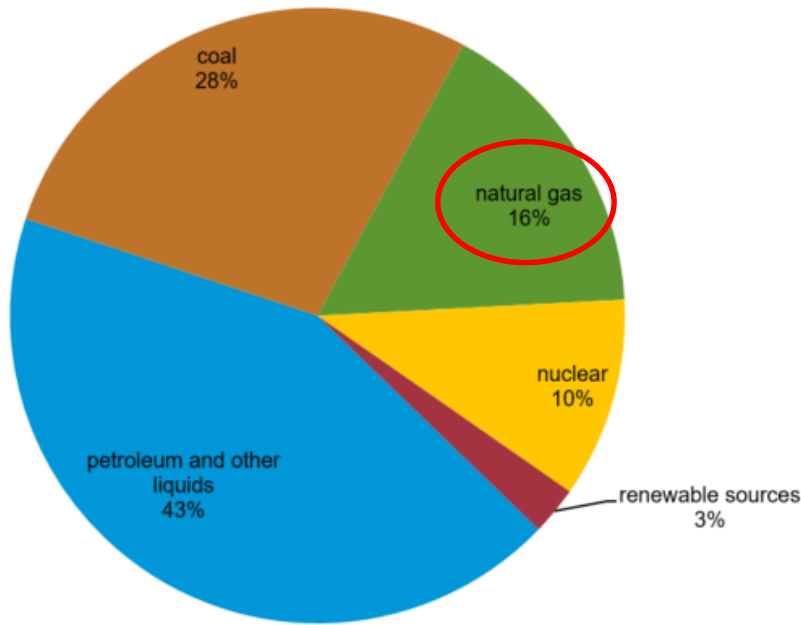
- How to transfer it (Video 02:00)



# 1.3 LNG Import to S. Korea

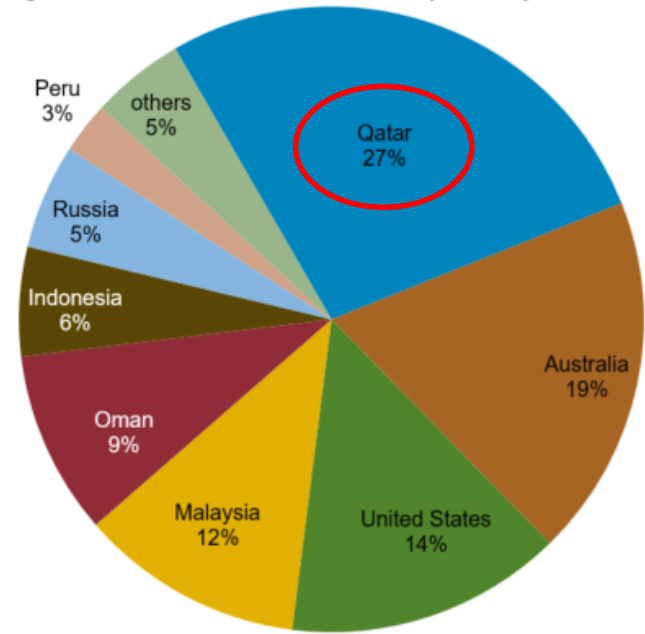
→ Mainly from Qatar

Figure 1. South Korea's total primary energy consumption by fuel type, 2019



eia Note: Petroleum and other liquids includes biofuels (ethanol and biodiesel)  
Source: BP Statistical Review of World Energy 2020

Figure 5. South Korea's LNG imports by source, 2019



eia Source: Global Trade Tracker (accessed May 2020)

## 1.3 LNG Import to S. Korea

- LNG storage tank in Incheon





## 1.3 LNG Import to S. Korea

- Why is natural gas liquefied? (Video 03:30)



## 1.4 Refrigeration System

- How we get cool temperature : Joule – Thomson Effect

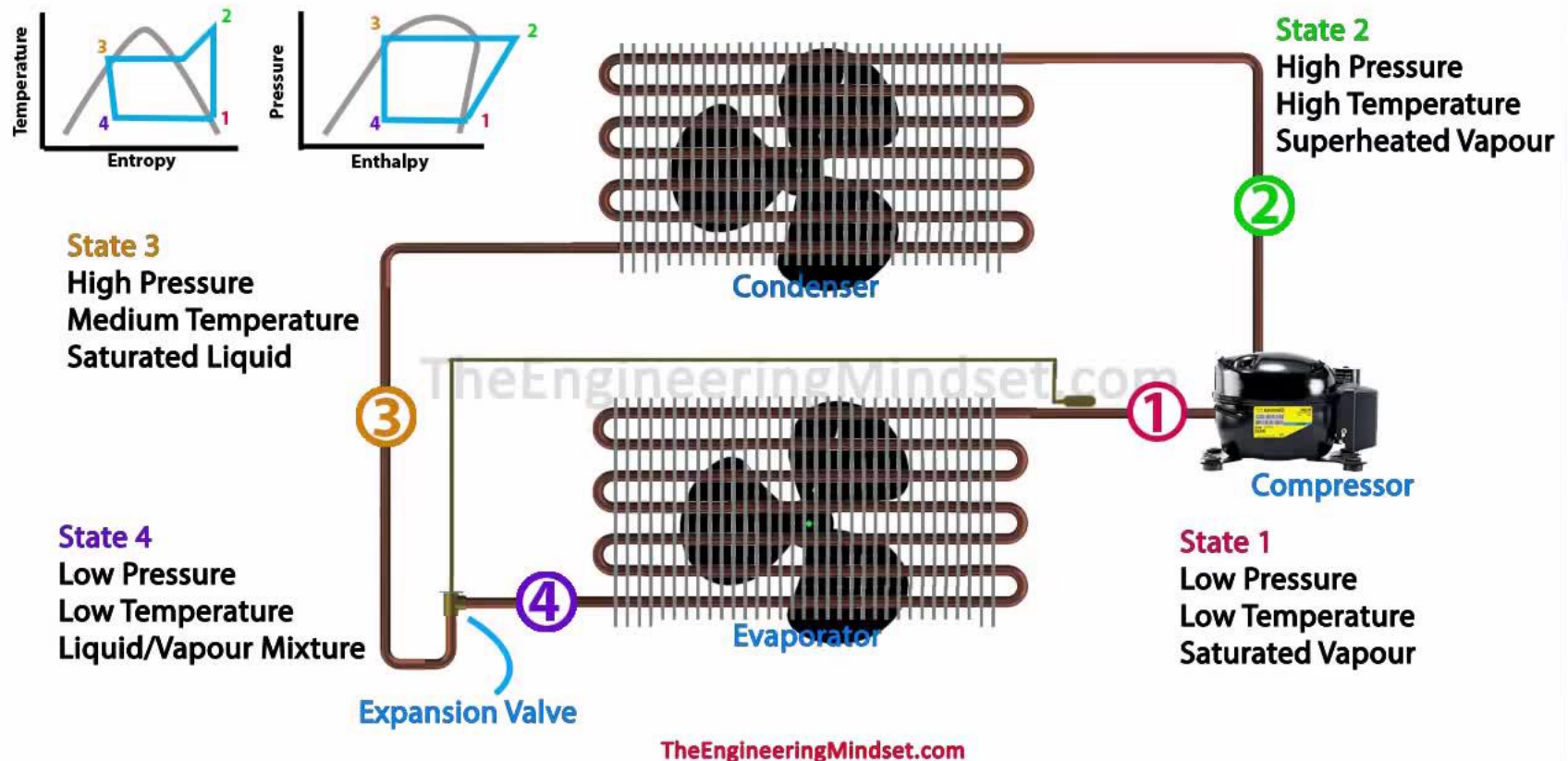


**Demo: Adiabatic Process**

# 1.4 Refrigeration System

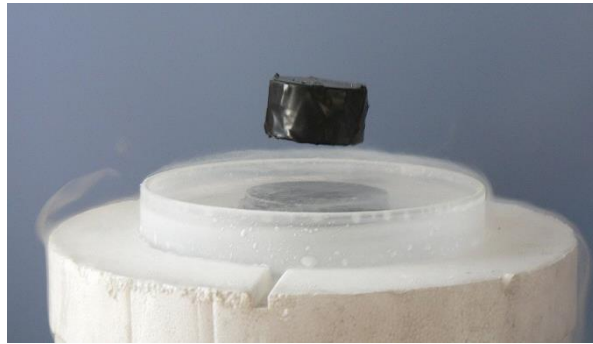
- Refrigeration system basics (Video 04:30)

## How Refrigerants Work

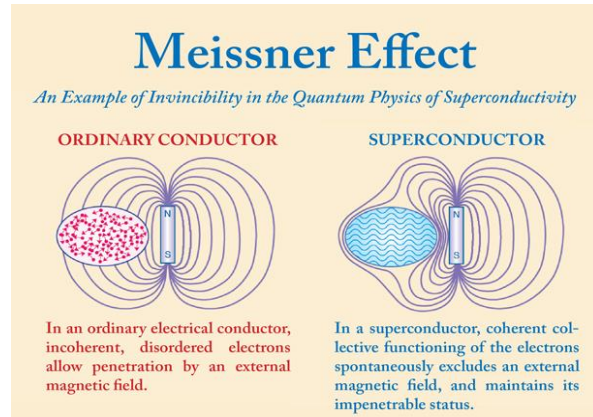


# 1.5 Cryogenic Engineering Related Fields

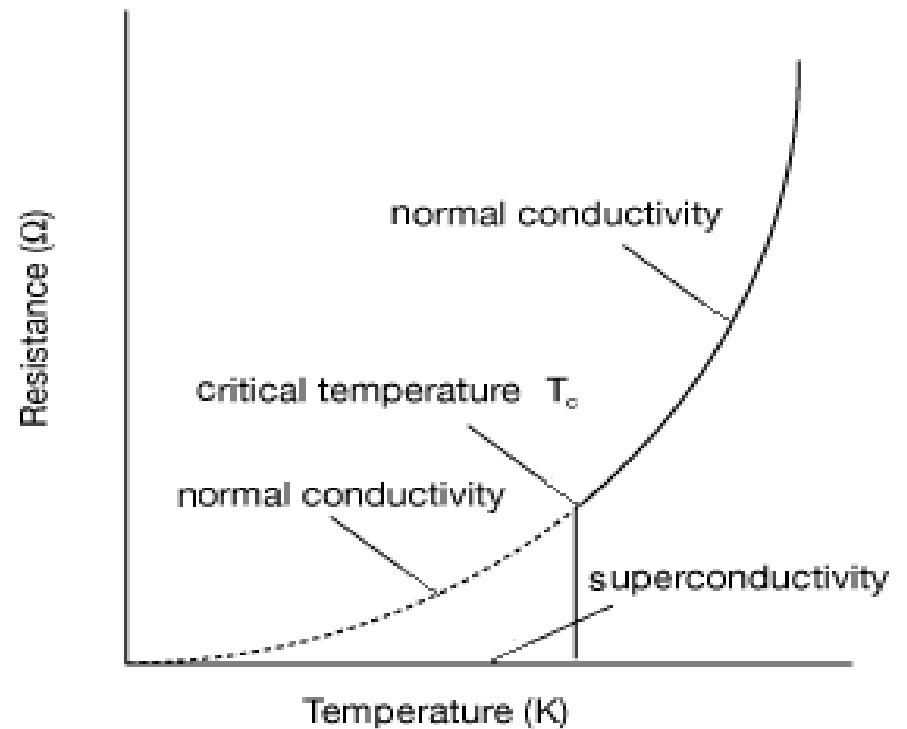
## ▪ Superconductivity



Superconductivity



Meissner Effect



Critical temperature of a superconductor

# 1.5 Cryogenic Engineering Related Fields

- **Superconductor (Video 05:00)**



## 1.5 Cryogenic Engineering Related Fields

- **Magnetic cooling (Video 04:00)**



## 1.5 Cryogenic Engineering Related Fields

- **Superfluid (Video 01:30)**

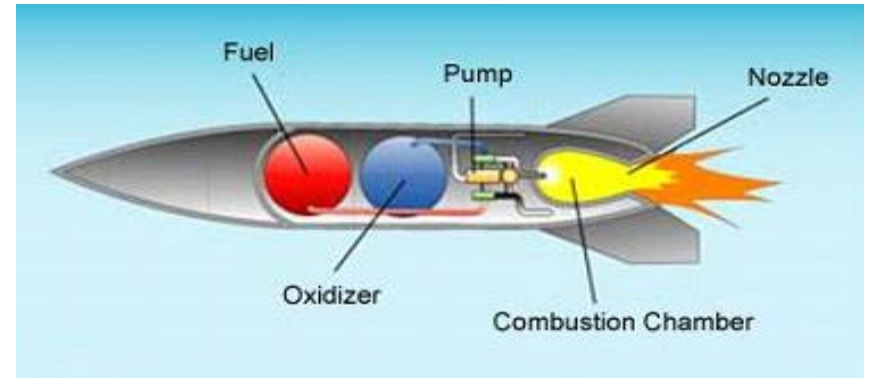


# 1.5 Cryogenic Engineering Related Fields

## ▪ Rocket propulsion



<Rocket propulsion>



<Diagram of a liquid fuel rocket>



<Carbon composite cryogenic fuel tank>