HOW ELECTRICITY IS GENERATED AND DISTRIBUTED

Fuels are obtained from an LNG terminal here and through pipelines from neighbouring countries.

1 Power sources

LNG terminal
This stores imported LNG (liquefied natural gas) from other countries and regasifies it for electricity generation.

Natural gas
This is imported from Indonesia and Malaysia through pipelines.

2 Power generation

Power plants
They generate electricity using natural gas and other sources of energy before transmitting it to the power grid.

3 Transmission and distribution

Energy Market Authority (EMA) oversees the transmission network while SP Group oversees the distribution network.

EMA
The authority ensures a reliable and secure energy supply, promotes effective competition in the energy market and develops a dynamic energy sector.

SP Group
A utility company regulated by the EMA, it transmits and distributes electricity to consumers via the national power grid.

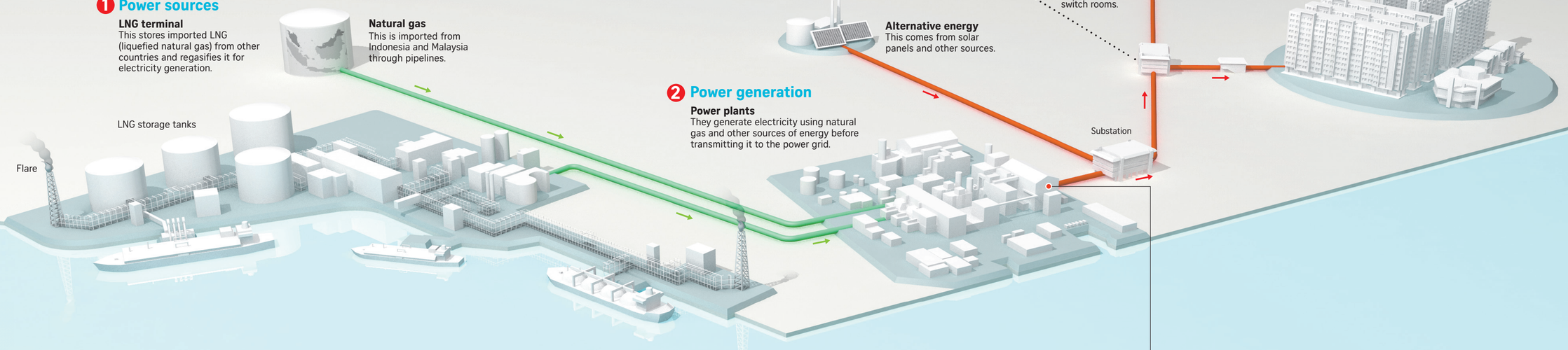
National power grid
The voltage is stepped down through a series of substations and the electricity is sent to consumer switch rooms.

Alternative energy
This comes from solar panels and other sources.

4 Delivery of power supply

Electricity is transmitted and distributed to consumers via the national power grid.

Consumers
Comprising households, businesses and factories, they can buy electricity either from SP Group at the regulated tariff or from a retailer at a price plan that best suits their needs in the Open Electricity Market.



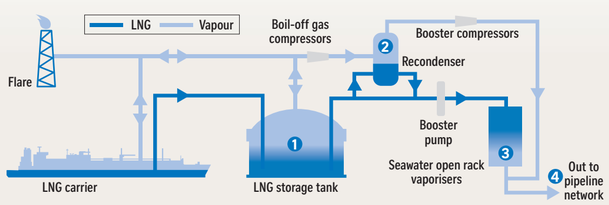
LNG TERMINAL

The Singapore LNG Terminal located on Jurong Island is Singapore's only liquefied natural gas terminal.

The LNG terminal receives and stores LNG unloaded from LNG carriers. The supercooled LNG is kept in special storage tanks until it is needed by power plants. But before it can be used, it must first pass through seawater vaporisers that raise its temperature and turn it back into gaseous form. The regasified natural gas is then sent through a network of pipes to power plants. The LNG terminal itself is located on a 40ha plot of land at the southernmost tip of the highly secured Jurong Island. Staff on 12-hour shifts monitor the terminal's operations round the clock from a control room.

How the LNG terminal works

Natural gas is liquefied and transported by tankers from overseas and regasified for distribution and sale.
1. LNG is pumped from carriers and stored in LNG storage tanks.
2. Boil-off gas, generated from the vaporised LNG in the tanks, is recondensed and recovered as LNG.
3. Seawater open rack vaporisers regasify LNG.
4. The gas is then sent through the pipeline network to power stations.

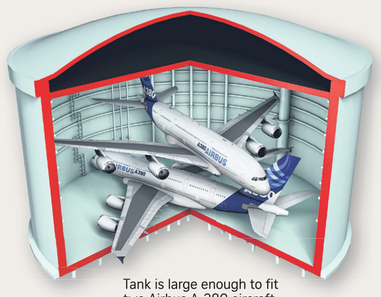


Natural gas and LNG

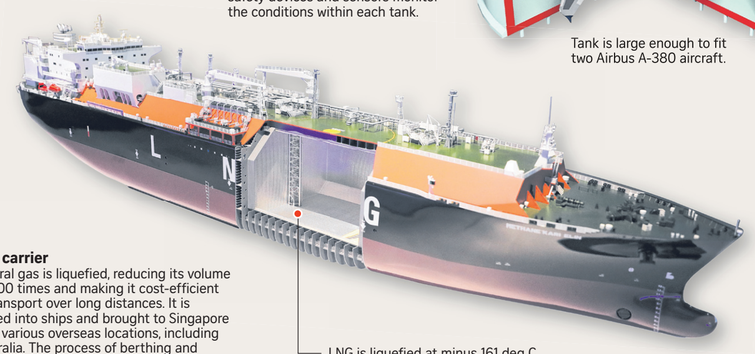
- Natural gas is odourless, colourless, non-corrosive and non-toxic.
- Tetrahydrothiophene, or THT, which has a strong pungent smell, is added to natural gas to make gas leaks more noticeable.
- LNG is less than half the weight of water.
- LNG is flammable only if the amount of gas is 5 per cent to 15 per cent in air.
- LNG is used mostly for electricity generation.

LNG storage tank

There are four such tanks on the SLNG premises, which can collectively hold 800,000 cubic m of LNG. Each tank is large enough to fit two Airbus A-380 aircraft, stacked on top of each other. Its inner layer is made of special combination of 9 per cent nickel steel, while the outer shell is concrete, with insulation materials in between the two layers, allowing them to withstand the sub-zero temperatures of the LNG. Multiple safety devices and sensors monitor the conditions within each tank.



Tank is large enough to fit two Airbus A-380 aircraft.



LNG carrier

Natural gas is liquefied, reducing its volume by 600 times and making it cost-efficient to transport over long distances. It is loaded into ships and brought to Singapore from various overseas locations, including Australia. The process of berthing and unloading the LNG takes around 24 hours.

LNG is liquefied at minus 161 deg C and transported in insulated tanks.

POWER PLANTS

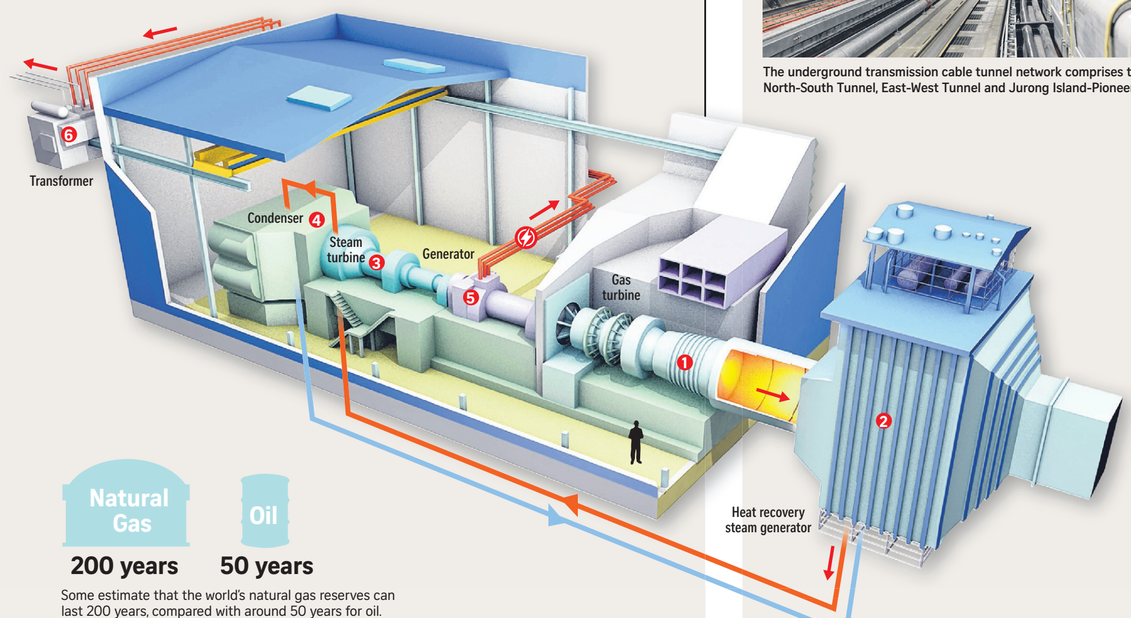
Keppel Merlimau Cogen, one of seven power plants in Singapore, has the ability to transmit 1,300MW of electricity into Singapore's power grid.

Seven power plants in Singapore generate most of the island's electricity for mass consumption. Most of these plants use what is known as combined cycle gas turbine technology to produce power.

This technology allows power plants to maximise input energy, harnessing heat that is produced from an initial energy generation process to create steam, which is used to generate even more electricity.

How technology in a power station works

1. A mixture of fuel and air enters the gas turbine. Combustion occurs, which powers the turbine and generates electricity.
2. Heat generated goes into the heat recovery steam generator, turning demineralised water into steam, which then travels to the steam turbine.
3. The blades of the steam turbine turn, generating electricity.
4. Residual steam goes into the condenser, which turns it into demineralised water and is pumped back to the heat recovery steam generator.
5. Electricity travels to a transformer.
6. The transformer steps up the voltage and sends the electricity to the grid.



200 years **50 years**

Some estimate that the world's natural gas reserves can last 200 years, compared with around 50 years for oil.

WATCHING OVER THE NETWORK

SP Group's distribution control centre where monitoring of the power grid and remote switching is done.

The entire energy process is jointly managed by the EMA's Power System Control Centre (PSCC) and SP Group's distribution control centre.

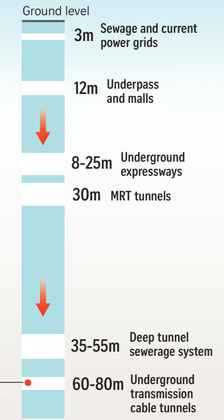
The PSCC uses sophisticated systems to monitor the pressure and flow of natural gas and to control power generation plants' output to ensure that overall demand is met. In the event of a power disruption, the PSCC coordinates responses by various stakeholders to ensure power is restored quickly.

The PSCC monitors the system until electricity is stepped down from 66kV, after which SP Group will take over.

The underground transmission cable tunnel network comprises three tunnels: North-South Tunnel, East-West Tunnel and Jurong Island-Pioneer Tunnel.

UNDERGROUND TUNNELS

High-voltage cables run through a 40km-long network of underground tunnels, serving as the 'highway' of the electricity network.



BY THE NUMBERS

-161 deg C
Temperature at which LNG is liquefied

>1,000 deg C
Temperature in the gas turbine

400kV
Highest voltage in the transmission network

14
Number of robots (above) that patrol the underground transmission cable tunnels

12,000
Estimated number of substations in Singapore

Sources: SLNG, KMC, EMA, SP GROUP ST PHOTOS: KEVIN LIM, KELVIN CHNG, ONG WEE JIN STRAITS TIMES GRAPHICS: LEE HUP KHENG