



Power Generation Today and Tomorrow

World Energy facts and figures

**17.3 Billion mwh produced in the world
In 208 countries**

US is No 1 with 3.9bill mwh

**China is No 2 with 2.5 bill mwh (set to
increase by 50% in the next 10 years)**

Coal produces 40%

**64 counties produce 100% of their
needs from coal**

Solar energy just 1/10 of 1%

**Geothermal just 44,709 mwh world
wide**

**440 operating Nukes producing 50% on
average of current world needs**

Sweden largest Nuke user per capita

**Lithuania produces the largest % of
power used from nuclear energy**

**Average natural gas consumption per
capita world wide 428 cu m**

**World production from only 86 source
countries 3 trillion cu m**

Known reserves 150 trillion cu m

**Enough for 50 years at current
consumption**

**1.3 trillion barrels of oil in known
reserves**

**World consumption average is
83mill/day**

**On average each person in the world
uses the equivalent of 5 tons of oil each
per year and the highest use is the US
at 8.63 TOE**

**By 2050 average electrical consumption
per capita could double**

**There are 6.6 billion people in the world
and there are still 1,6bill people on
earth with no electricity at all. 24%**

Power Generation

Nuclear

Traditional Thermal

Gas Turbines

- Simple cycle, Combined cycle

Hydro

ICE

- Simple cycle, Combined Cycle

Geothermal

Wind

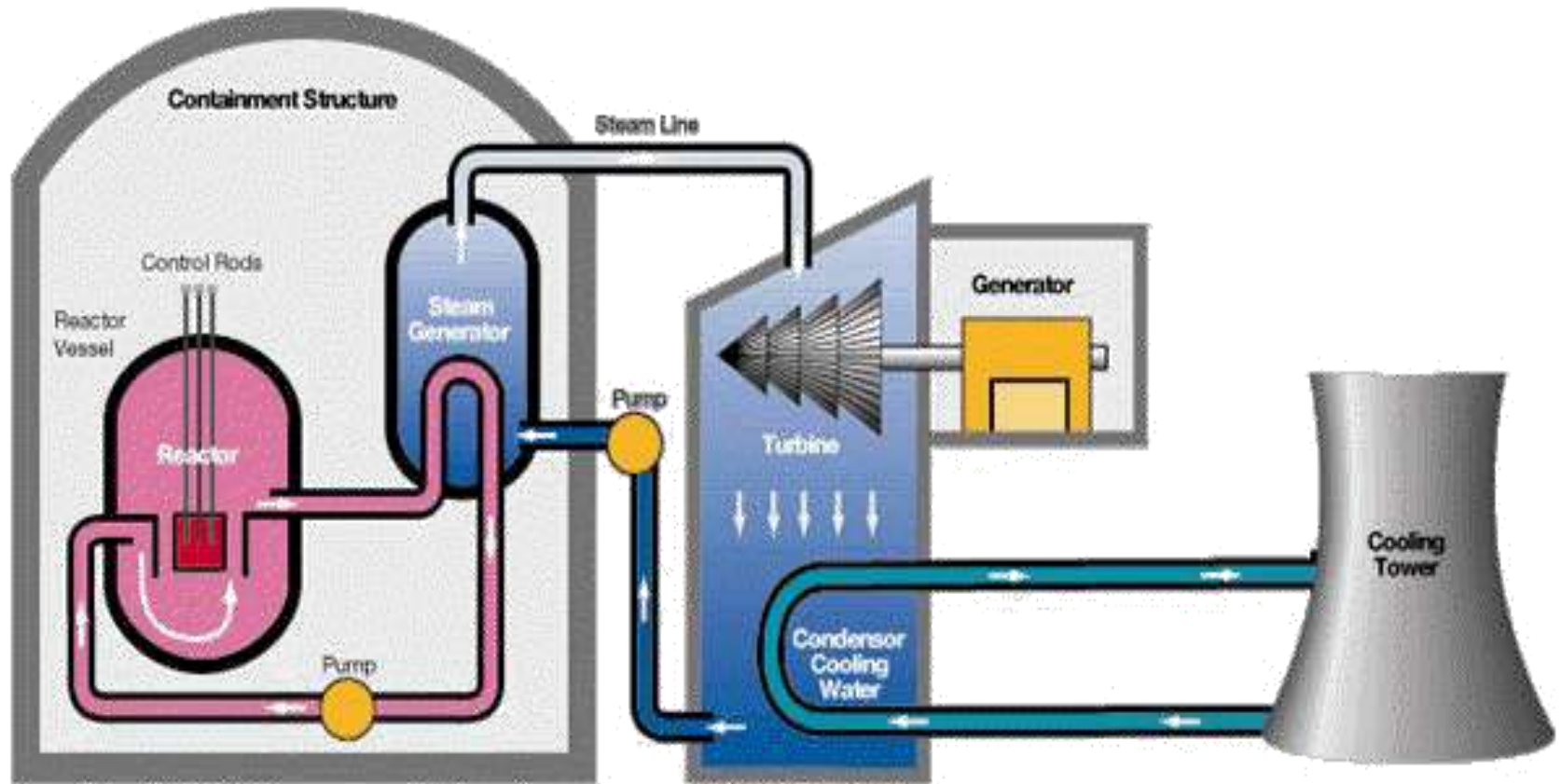
- Onshore, Offshore

Solar, Wave, Hydrogen Fuel Cells

% Electricity Production per Country by Nuclear Generation

Lithuania	77.7%	UK	23.7%
France	77.1%	Taiwan	22.6%
Belgium	59.3%	USA	20.7%
Slovakia	53.6%	Czech Rep	20%
Bulgaria	44.1%	Russia	14.8%
Ukraine	43.5%	Canada	12.9%
Sweden	43%	Romania	9.9%
Hungary	39%	Argentina	6.7%
Switzerland	37.1%	South Africa	5.5%
Slovenia	36.8%	Brazil	4.4%
S Korea	36.6%	Netherlands	4.3%
Armenia	30.7%	Mexico	4.2%
Finland	30.4%	India	3.4%
Germany	29.9%	Pakistan	3%
Japan	29.8%	China	1.2%
Spain	27.2%		

PWR Nuclear Reactor



Bruce Power Generating Station, Toronto, Canada

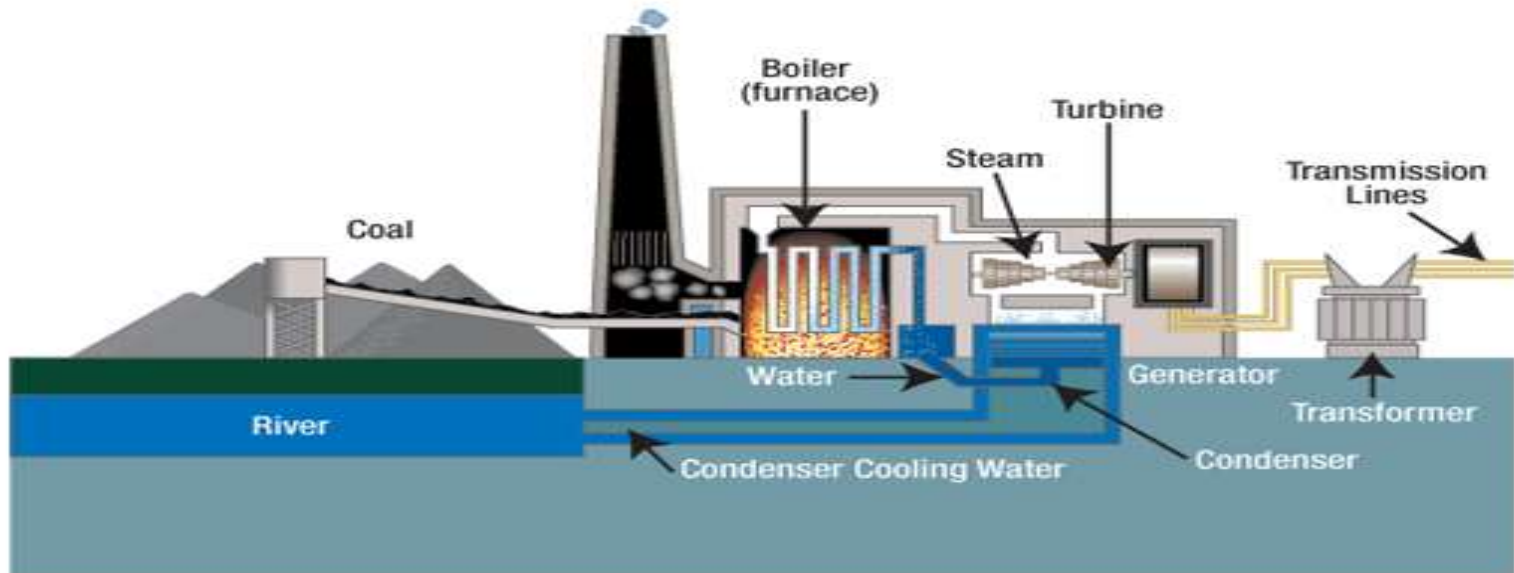


Courtesy of Bruce Power

Bruce Power Generating Station is in Toronto, Ontario, Canada. It is the largest nuclear power generating plant in North America and the second largest in the world. Owned by Ontario Hydro, BPGS is located on the shores of Lake Huron, 250km north-west of Toronto.

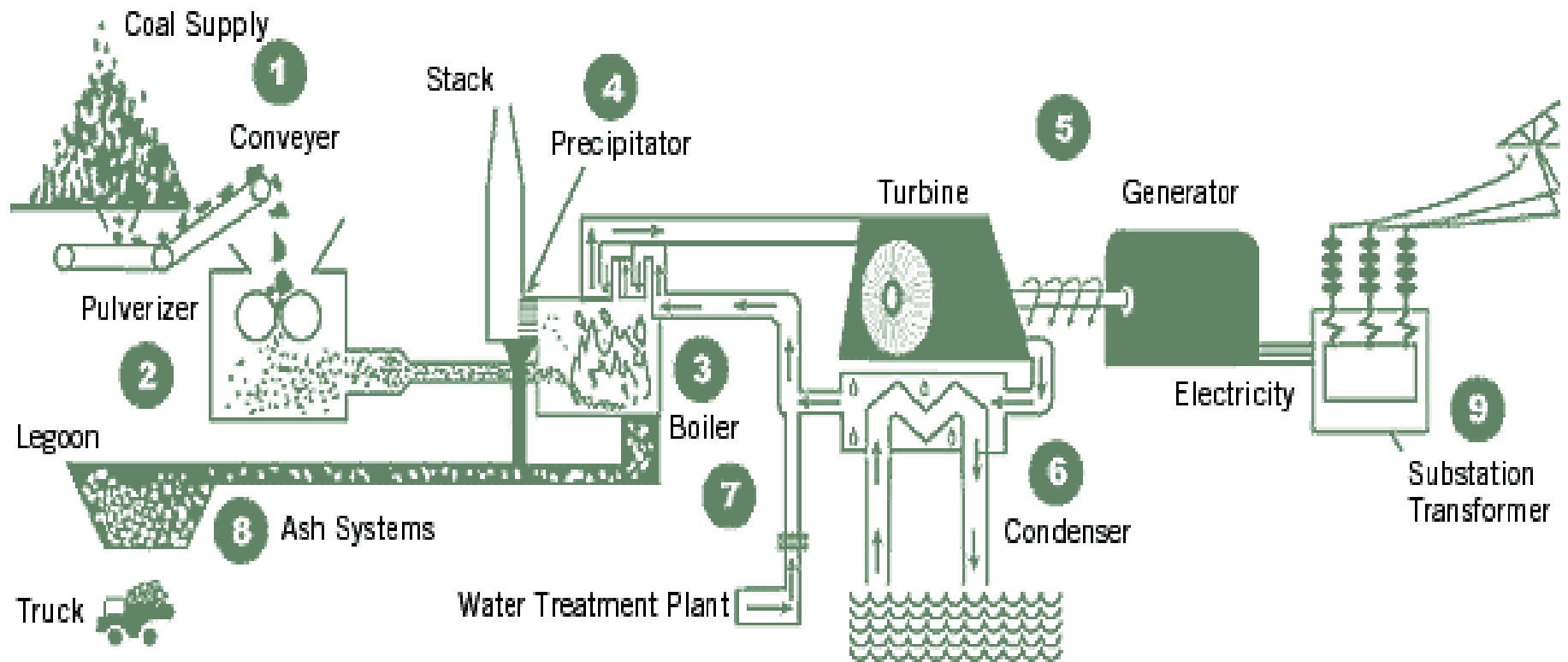
It generates 20% of Ontario's electricity. The plant generates around 6,232MW (net) of emission-free electricity

Typical Coal Fired Thermal



The Thermal cycle

Components of a coal-fired thermal plant



Source: Canadian Clean Power Coalition

Some examples

Drax Power Station Selby. At 4000mw (6 x 660mw) the UK's largest coal fired Station



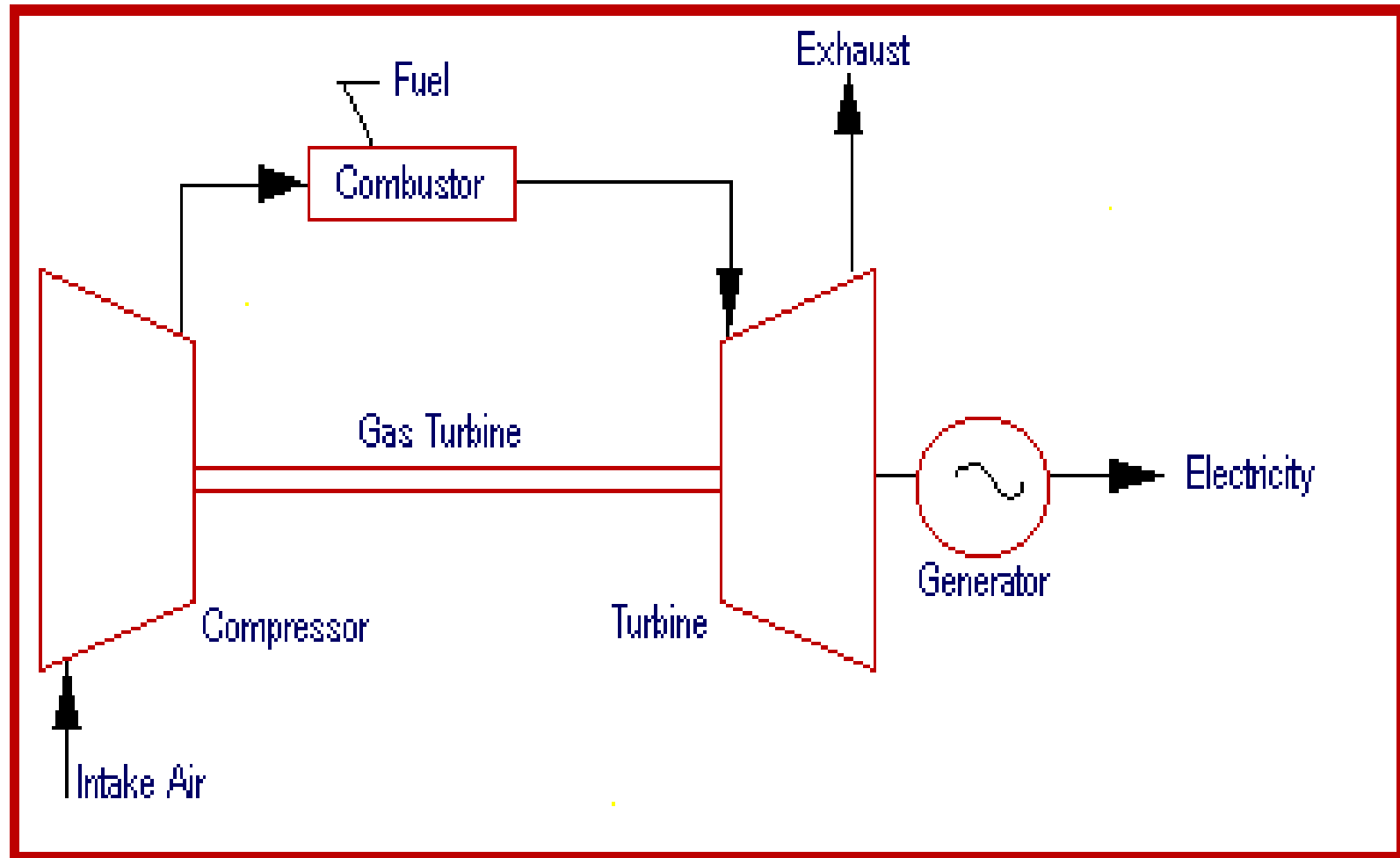
Drax Turbine Images

HP Power Turbine

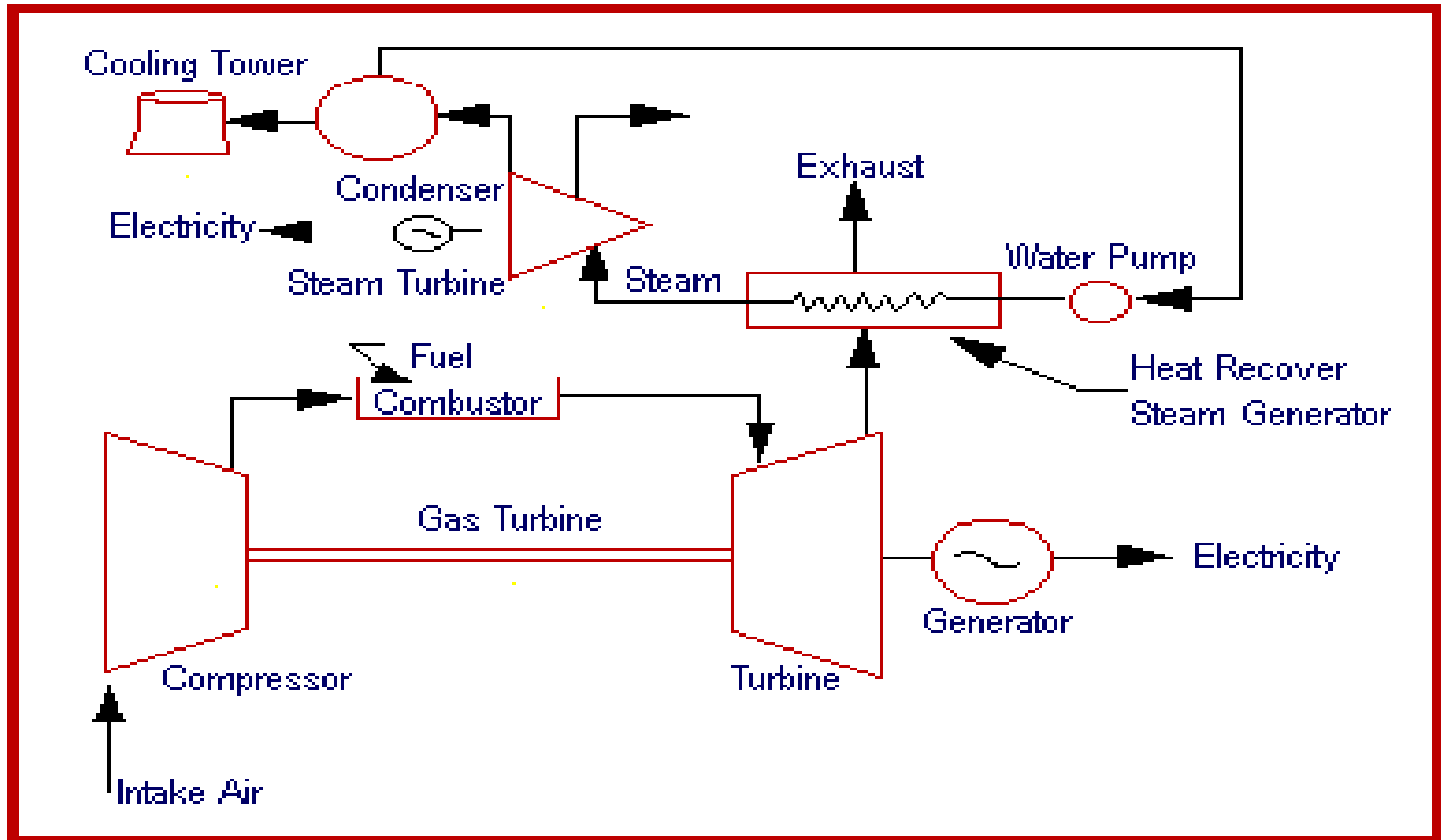
– IP Power Turbine



Simple Cycle



Combined Cycle



Gas Turbines Siemens H machine

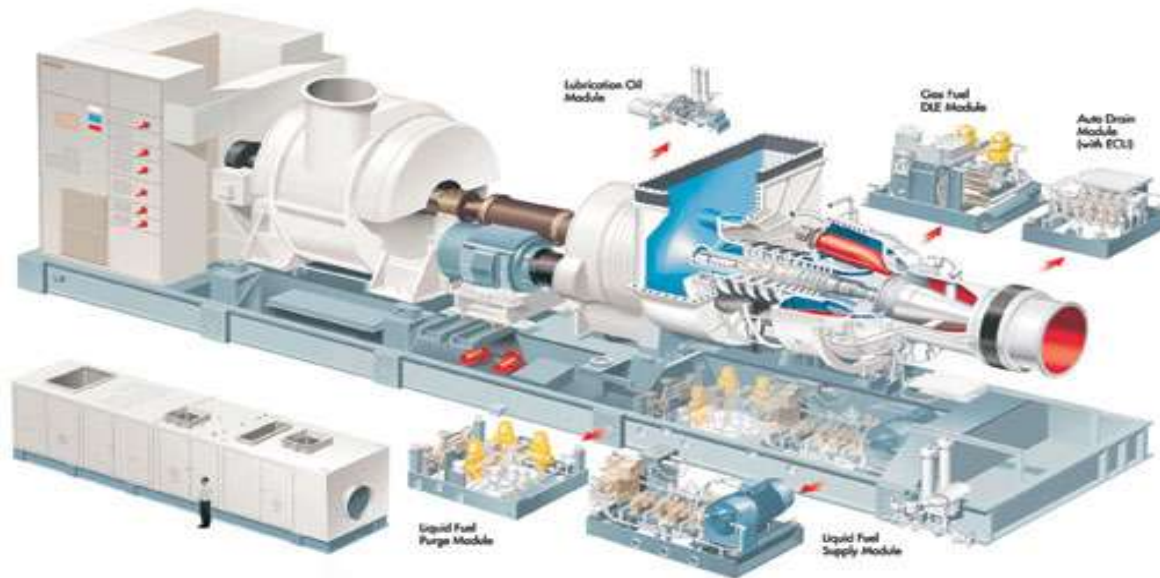


The SGT5-8000H completed its test run in the Irsching 4 power plant on August 28, 2009. Based on test results, the gas turbine will be offered with an actual rated output of 375 MW and 40 percent efficiency. It is currently being developed into a combined-cycle power plant. In combined cycle gas turbine operation, the SCC5-8000H 1S single-shaft system will achieve an output of over 570 MW at an efficiency of more than 60 percent.

GE 9FA stand alone 256mw

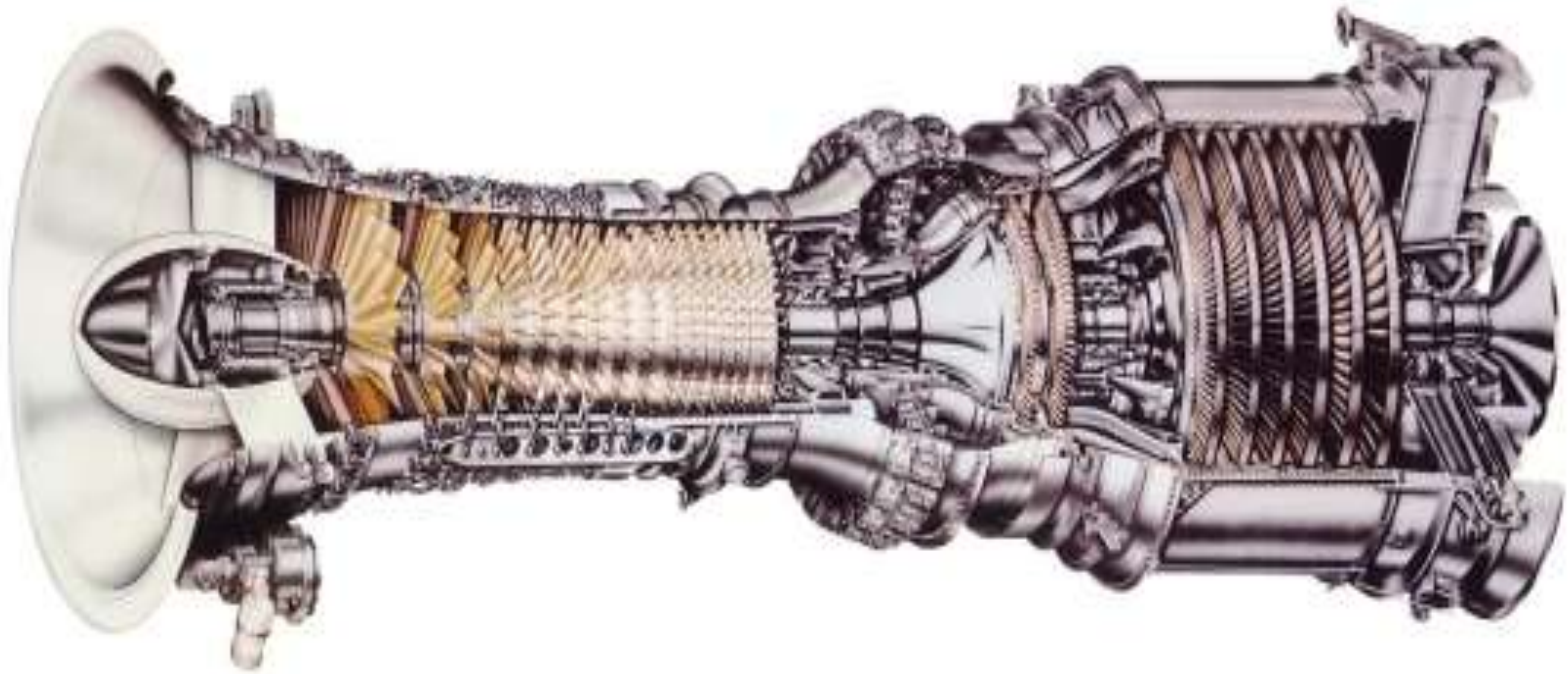


Alstom Typhoon GT 56 / 115mw



The Typhoon is available as a factory assembled package power plant for utility and industrial power generation. The package incorporates the gas turbine, gearbox, generator and all systems mounted on a single underbase.

LM 2500 Gas Turbine 20/25mw

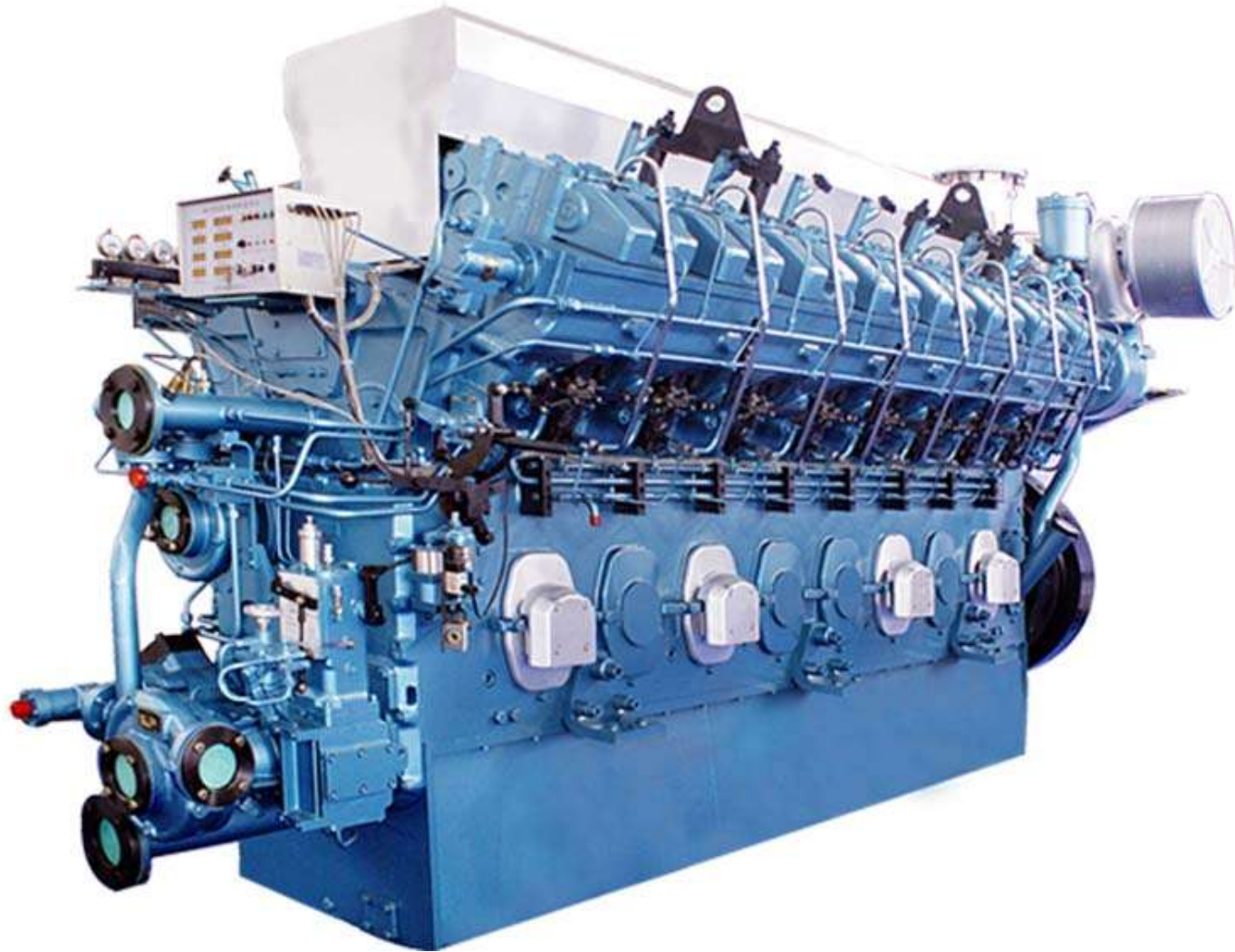


Diesel Engine

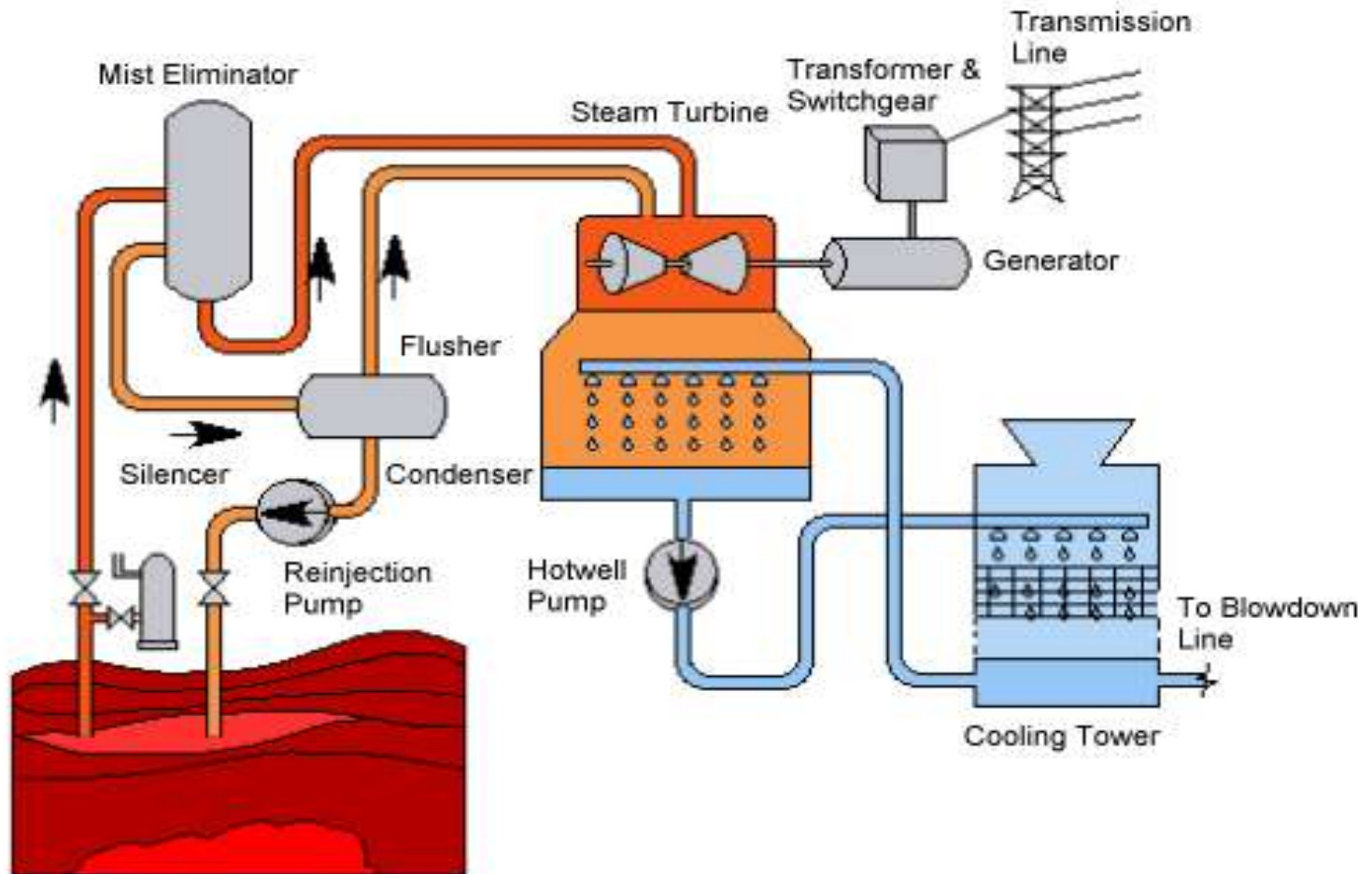


A Typical slow speed, in this case, Marine application Diesel Engine which for shore based generation can be operated in either open (or simple) cycle or in combined cycle with the addition of an HRSG and a steam turbine driven generator.

Another Slow Speed Diesel

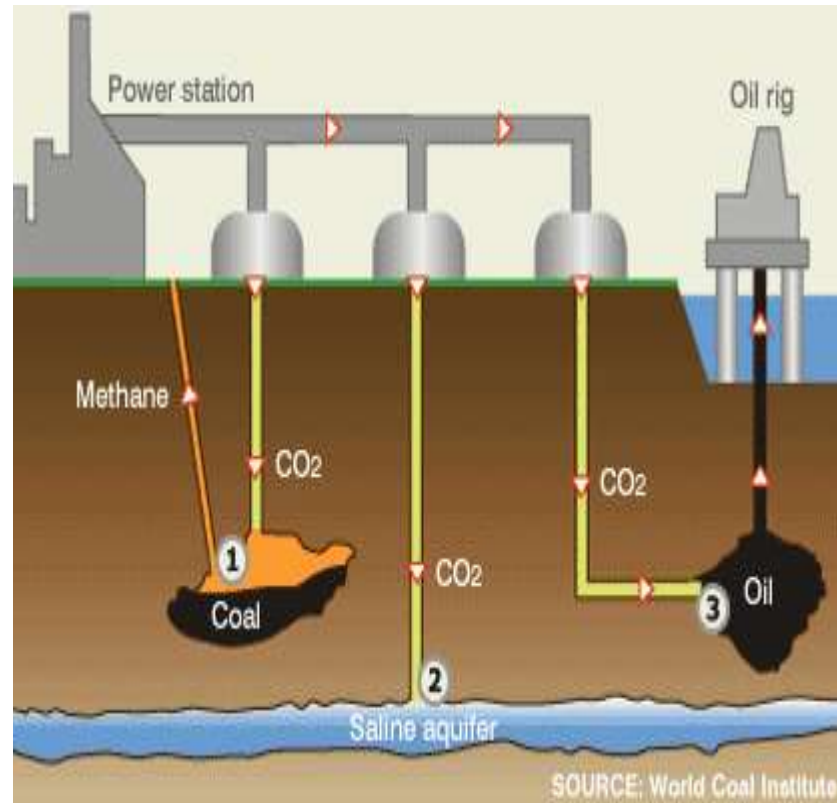


Geothermal Energy



Carbon Capture and Storage (CCS)

Proposed CCS Units



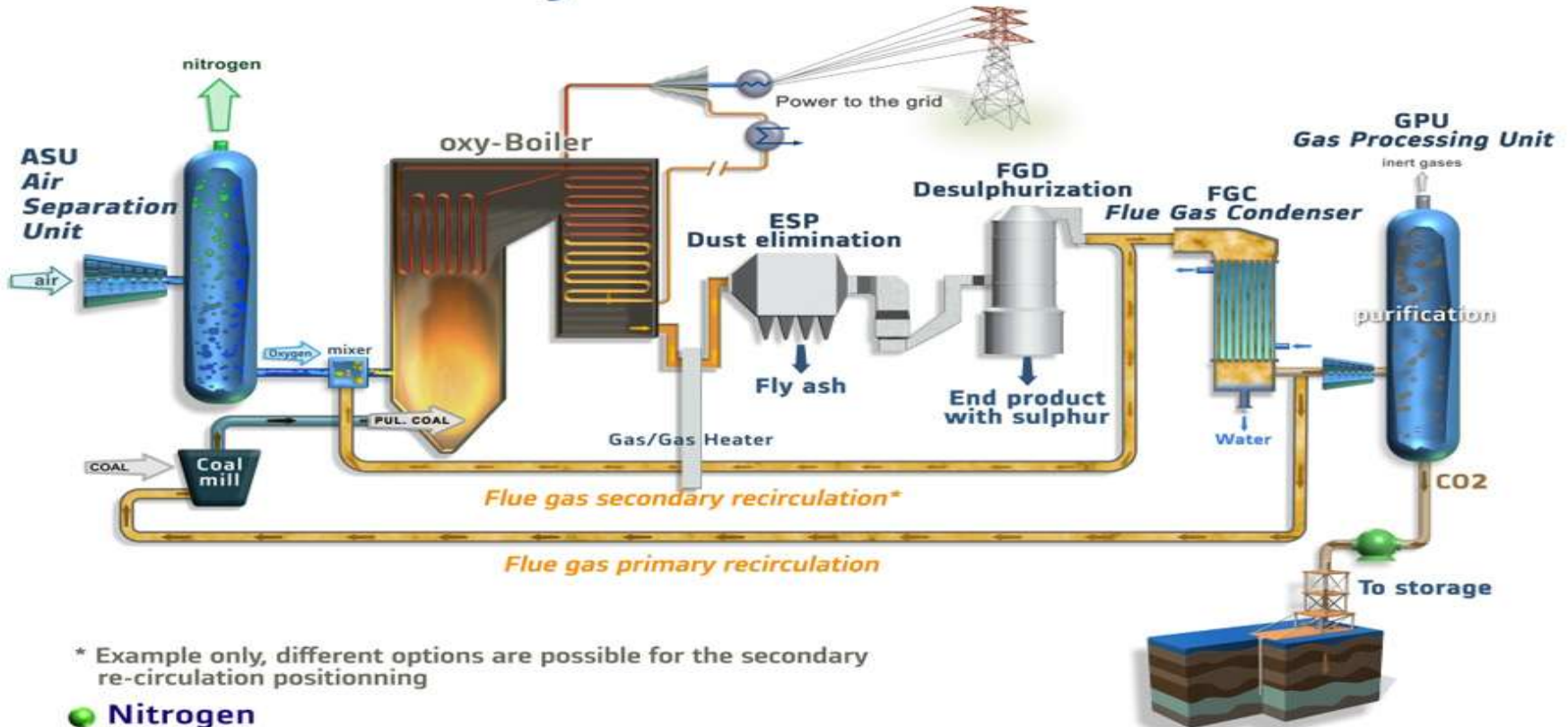
Despite the improving efficiency of coal-fired power stations, CO₂ emissions remain a problem.

Carbon capture and storage (CCS) involves capturing the carbon dioxide, preventing the greenhouse gas entering the atmosphere, and storing it deep underground.

- 1. CO₂ pumped into disused coal fields displaces methane which can be used as fuel**
- 2. CO₂ can be pumped into and stored safely in saline aquifers**
- 3. CO₂ pumped into oil fields helps maintain pressure, making extraction easier**

Clean up of fossil fuelled Plants (Carbon Capture)

Oxy PC Power Plant

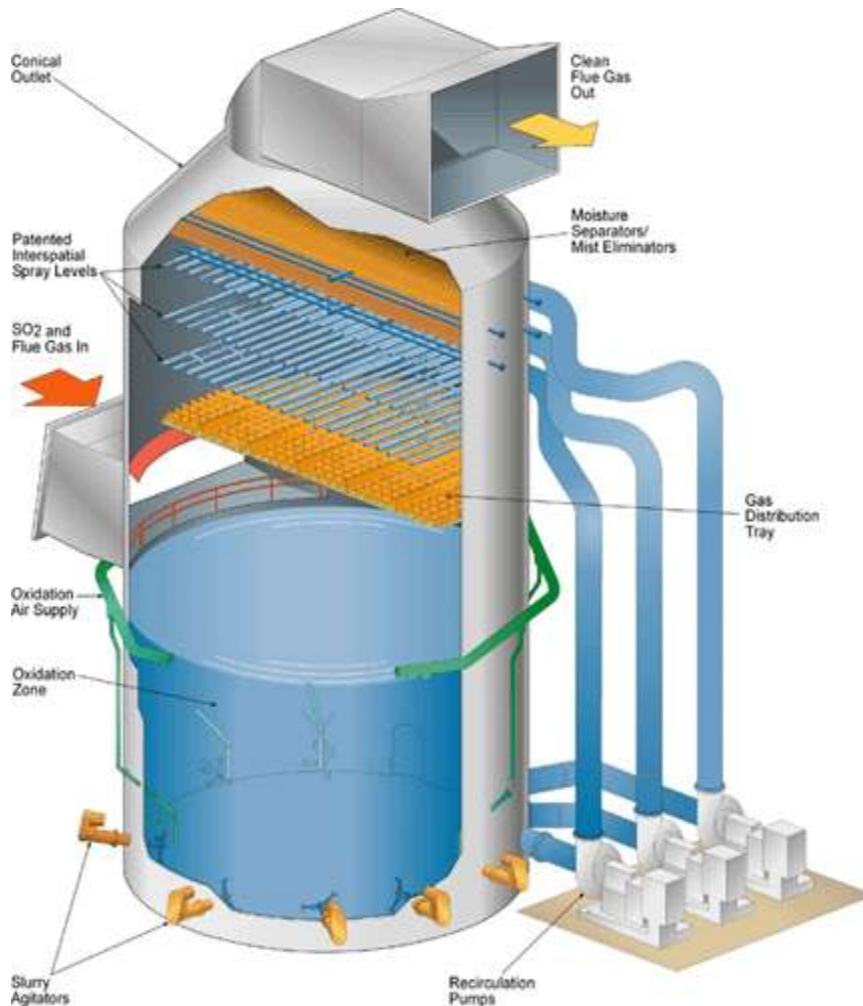


* Example only, different options are possible for the secondary re-circulation positioning

- Nitrogen
 - Oxygen
 - CO2
 - PUL. COAL= Pulverized coal
 - Pumps
 - Compressors
- ALSTOM**

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FGD (Flue Gas Desulphurisation)



Design features:

Spray tower scrubber design used for SO₂ control, with patented tray design for more uniform flue gas distribution and improved absorption.

Applicable boiler sizes:

50 MW to 1300 MW.

Removal efficiencies:

To 99%.

Reagents:

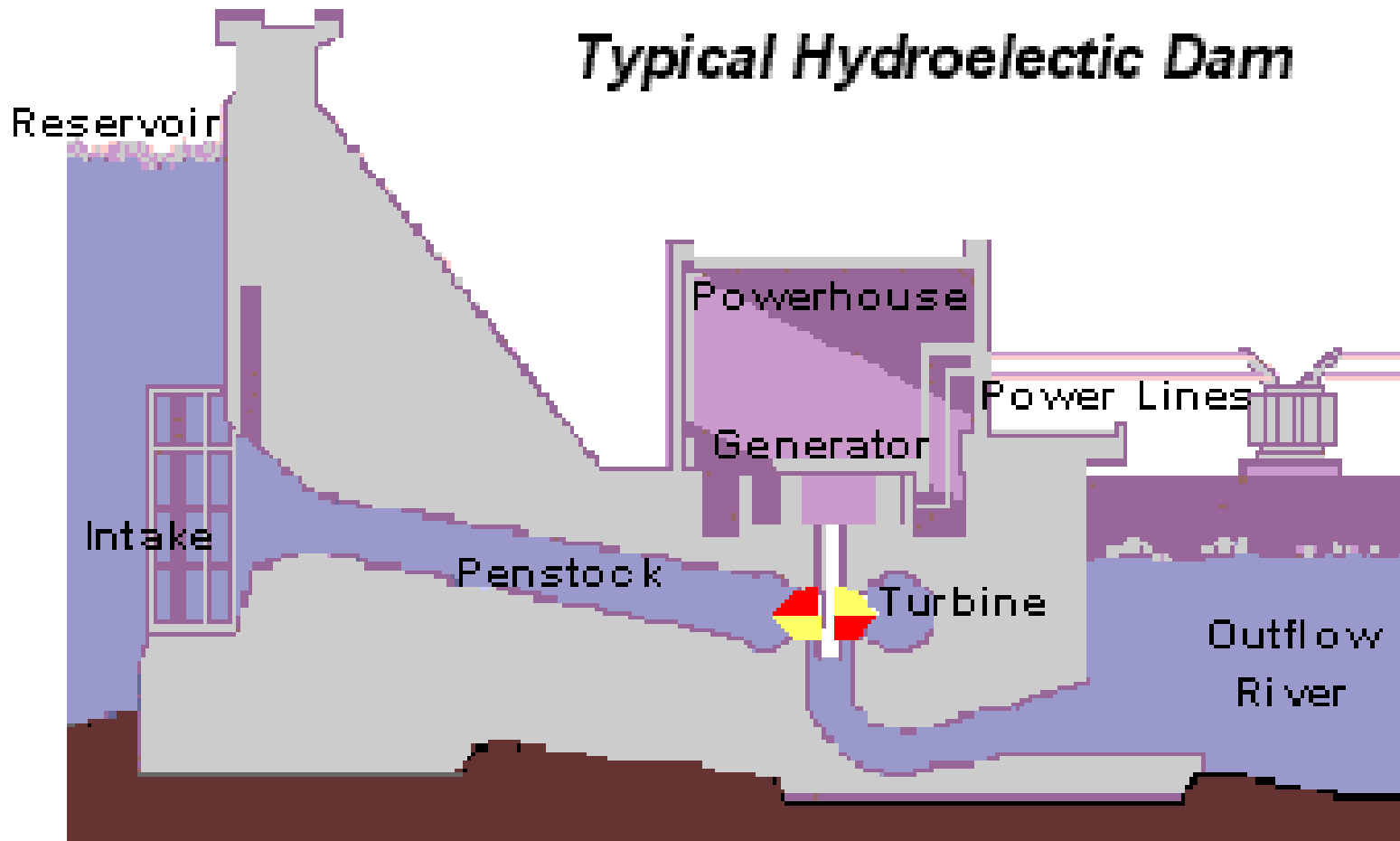
Primarily limestone; also lime, magnesium-enhanced lime, sodium carbonate and ammonia.

Fuels:

All solid fuels - primarily coal.

Hydro Electric Generation

Typical Hydroelectric Dam



China's 3 Gorges Hydro



3 Gorges China. The dam stretches 7,661 feet long, 331 feet high and 377 feet wide at the base, towering over nearby cliffs and peaks that reach more than one mile high. Controlling the Wuxia Gorge, Xiling Gorge, and the Outang Gorge.

It has a potential power output, when completed in 2011 of over 19,000mw.

Itaipu Brazil

Construction started in January 1975 and finished in 1982.

It took 30,000 people 7 years to build the Itaipu Dam.

It cost \$20 billion to build.

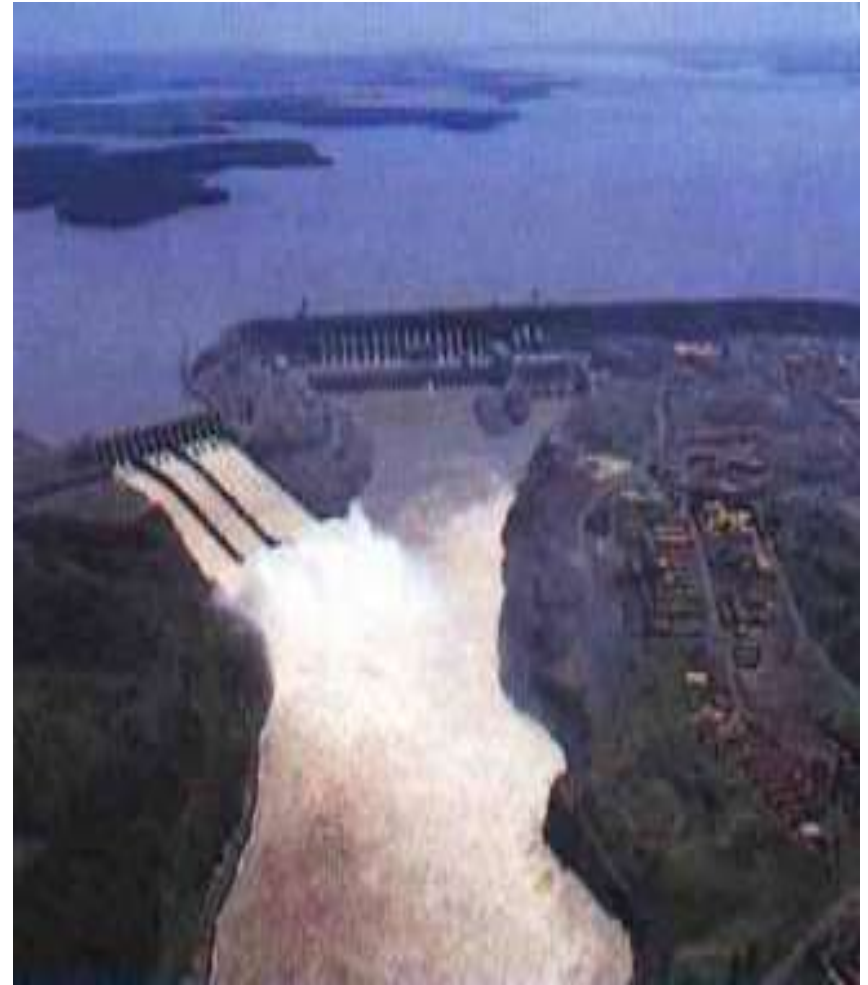
The dam supplies electricity to Brazil and Paraguay.

The dam is 7.76 kilometres long and 196 metres high.

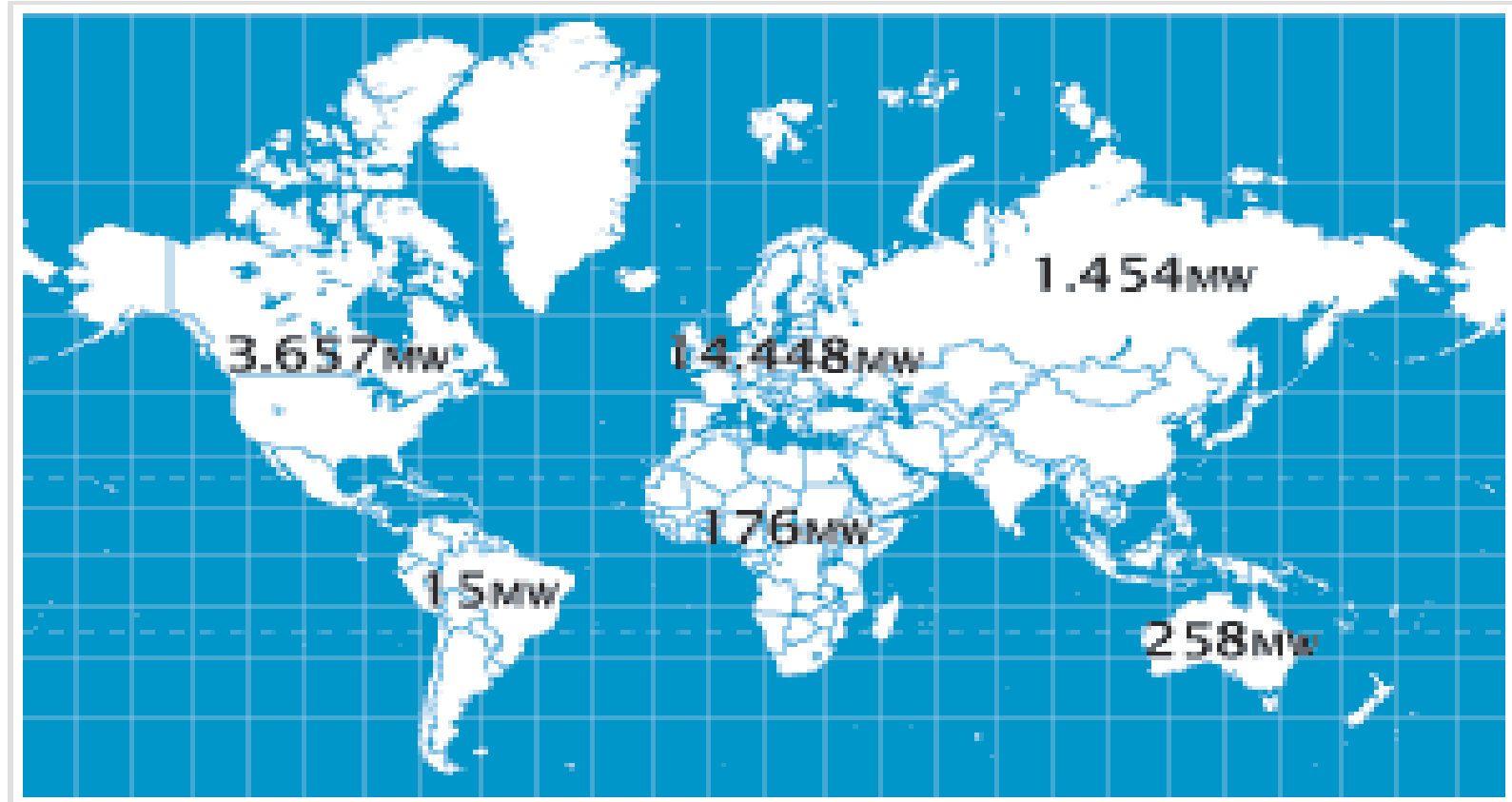
The reservoir behind the dam has an area of 1350 square kilometres.

It is a hollow gravity type dam.

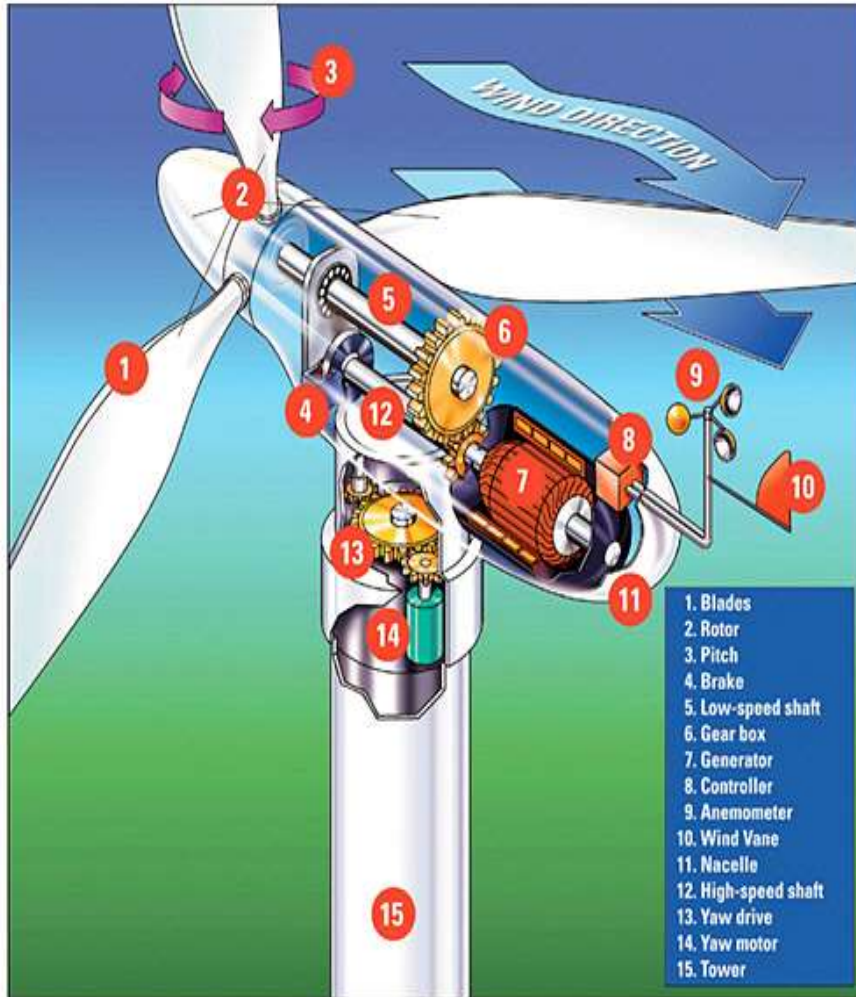
The Itaipu Dam generates 75 billion kilowatts of electricity per year.



The World by Wind Power Generated



Wind Turbines



Wind turbines are used to generate electricity from the kinetic power of the wind. Historically they were more frequently used as a mechanical device to turn machinery. There are two main kinds of wind generators, those with a vertical axis, and those with a horizontal axis. Wind turbines can be used to generate large amounts of electricity in wind farms both onshore and offshore.

Largest onshore Wind Farm in the world



Penascal Wind Farm (PWF) is the largest onshore wind power plant in the world. It is built on 300 acres of private land in Kenedy County, Texas. The plant is operated by Spanish company Iberdrola. PWF has an installed capacity of 404MW..

It cost \$440m

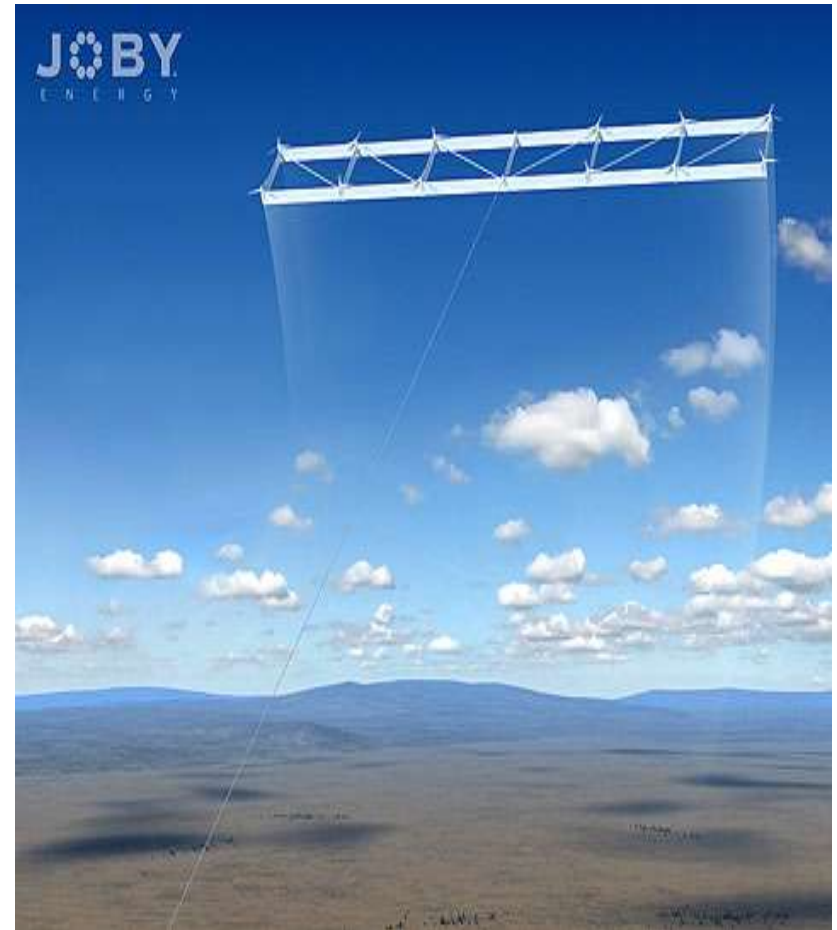
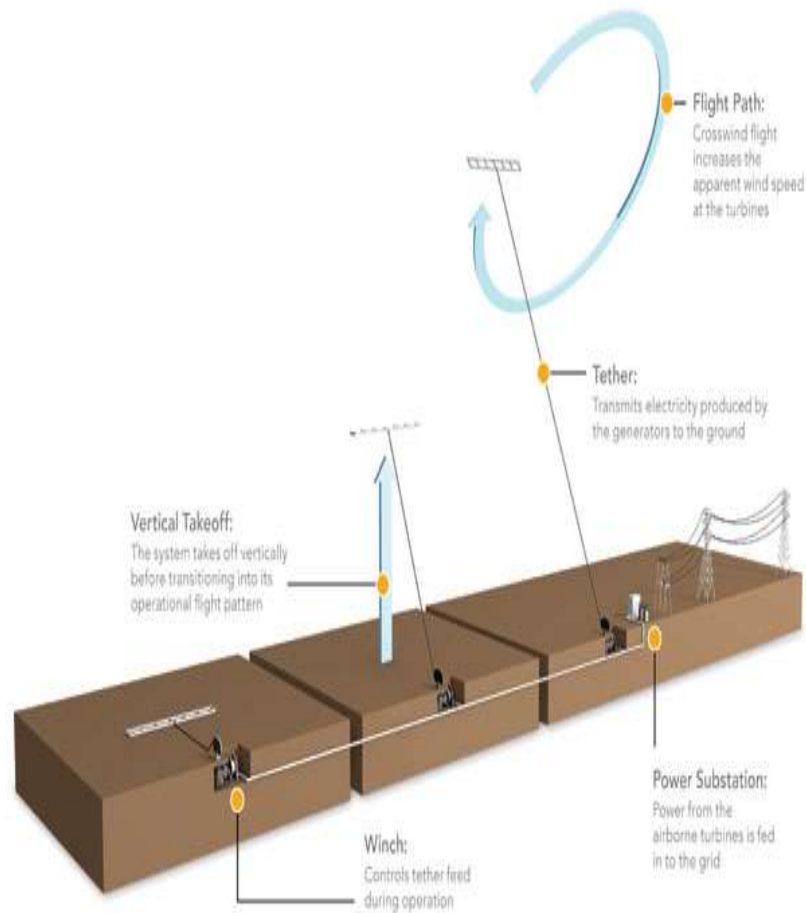
Wind Power alternatives



Designed by students at the University of Arizona, these turbines are able to harvest the wind generated by cars passing by.

Estimates say that the turbines can create about 9.6mwh per year and could be used for powering traffic signals and other devices around the road.

Airborne wind turbines designed to operate in the upper boundary layer and the upper troposphere.



La Florida Solar Power Plant Spain.



One of the largest installations in the world, the plant has the capacity to generate 49.9MW power, using parabolic trough collectors.

Solar power production in Spain now equals that of a single nuclear plant. The plant is estimated to reduce more than 160,000t of CO₂ every year.

The construction of the plant began in July 2008 and was completed in June 2010.

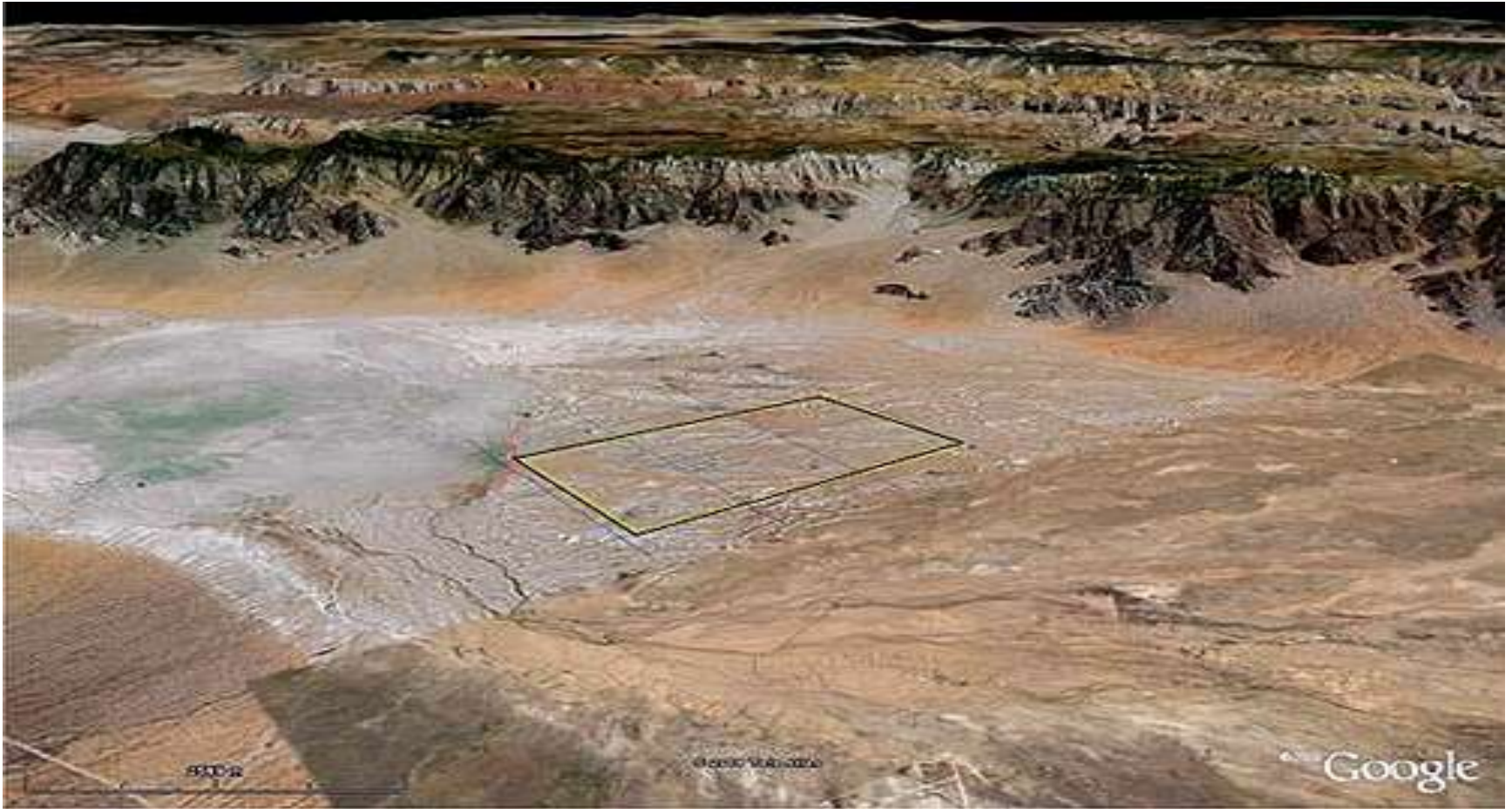
Phoenix Solar Thin Film Photovoltaic Plant, Singapore The BIPV Skylight installed on the rooftop of Applied Materials' Singapore Operations Centre.



Hualapai Valley Solar plant, which is owned and operated by Mohave Sun Power LLC.



The HVS project is located in 4,000 acres of private land 100 miles south of Las Vegas, Arizona.



Solar Powered City, Abu Dhabi



Solar Energy Test Facility



Sandia National Laboratories/PIX03212

Sandia's National Solar Thermal Test Facility is an important resource for users and manufacturers of solar thermal power systems. Manufacturers can use the NSTTF to test new designs, ideas, and products in an outdoor environment much like the environment the equipment will be in when it is used in the field.

Wave Energy



Wave energy is produced when electricity generators are placed on the surface of the ocean. The energy provided is most often used in desalination plants, power plants and water pumps. Energy output is determined by wave height, wave speed, wavelength, and water density. To date there are only a handful of experimental wave generator plants in operation around the world.

Wave generator

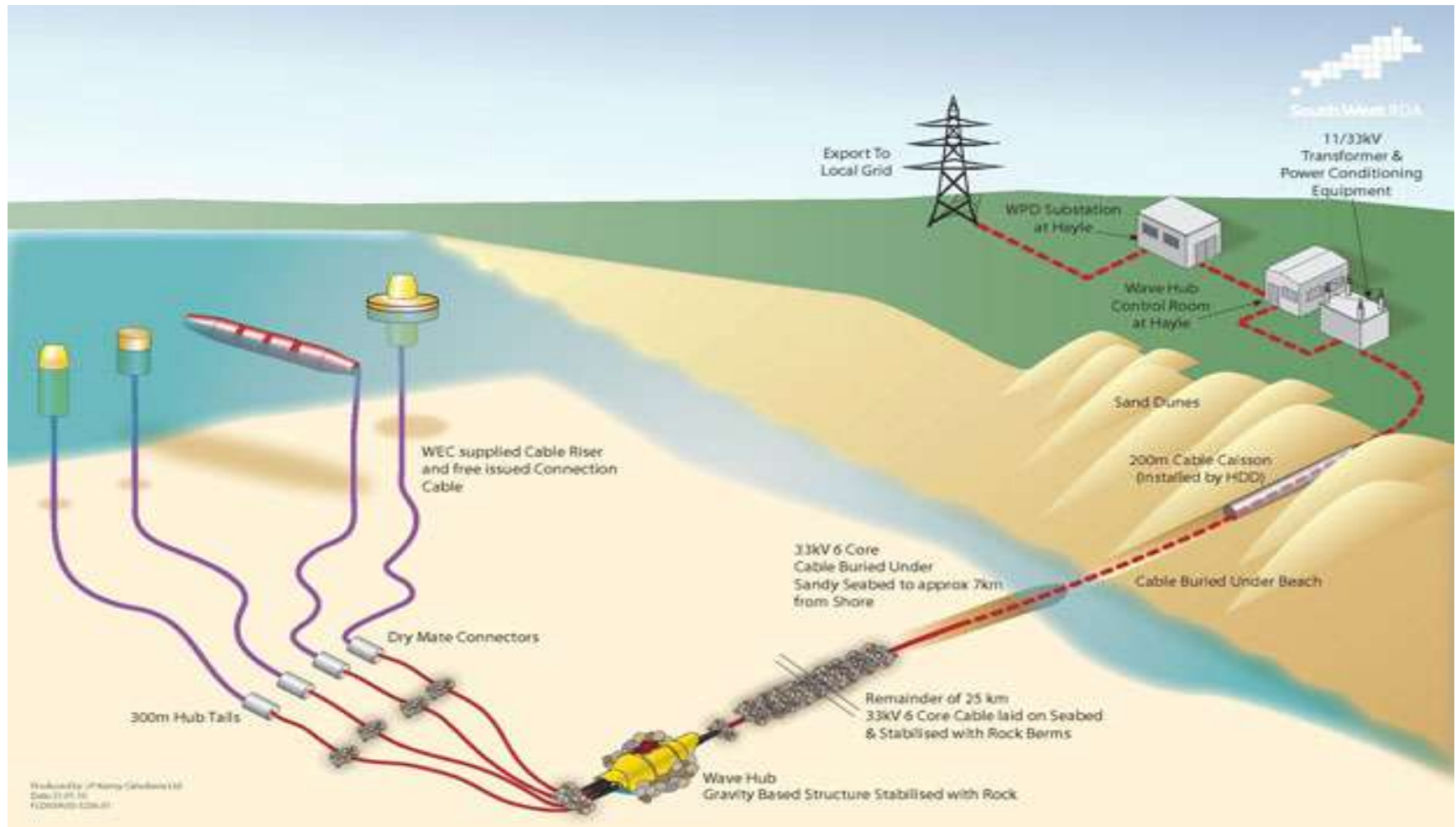
The Pelamis Wave Energy Converter is a full-scale prototype that was the world's first commercial-scale wave energy converter. Launched at the European Marine Energy Centre (EMEC) in Orkney, Scotland, the semi-submerged converter has hinged joints that use the motion of the sea to pump high-pressure fluid through hydraulic motors, which drive electrical generators to produce electricity.



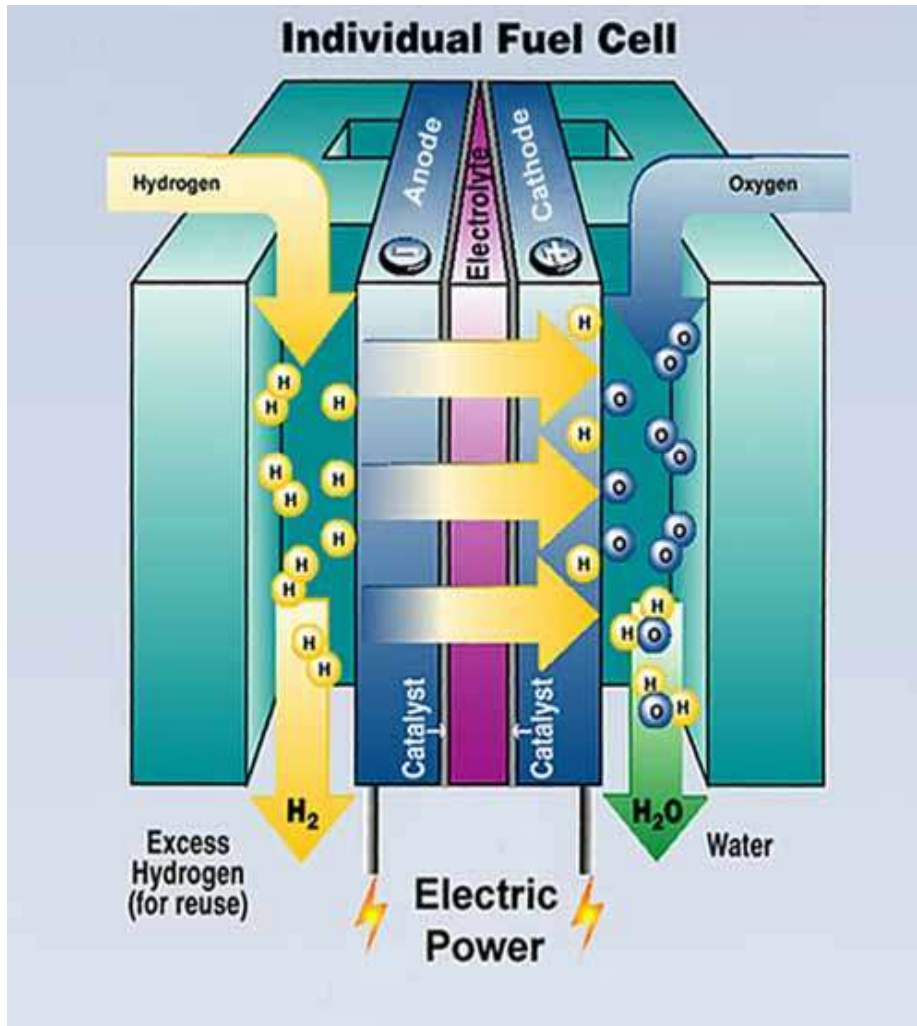
Wave generator



Wave energy Hub planned for Cornwall UK



Hydrogen Fuel Cells



Hydrogen is the most plentiful element not only on Earth but also in the universe, accounting for 90 percent of the universe by weight. However, it is not commonly found in its pure form, since it readily combines with other elements and is most commonly found in combination with oxygen in water, and in organic matter including living plants, petroleum, coal, natural gas and other hydrocarbon compounds. The great attraction of hydrogen is that, once isolated, it is a clean burning fuel that produces neither carbon dioxide (a greenhouse gas) nor toxic emissions and can be used for electricity production, transportation, and other energy needs

Thanks for Listening