

NON- RENEWABLE AND RENEWABLE ENERGY RESOURCES

ENERGY RESOURCES



Today the greatest attention in the world is devoted to energy resources because their use is usually irreversible, but the supplies of traditional fossil fuels (oil, natural gas) are running out fast. This is why over the last decades attention is focused on renewable energy resources and ways to increase energy efficiency.

ENERGY SOURCES

NON-RENEWABLE

Oil
Natural gas
Coal
Nuclear energy

RENEWABLE

Sun energy
Hydro energy
Wind energy
Geothermal energy
Biomass energy
Tidal energy

SECONDARY

Electricity
Hydrogen

Coal

Coal is traditionally looked upon as the most typical fossil fuel. Today coal is primarily used for energy and coke production for producing iron and steel.

Coal of a lower quality is used in cement and food production as well as in several less important industries.

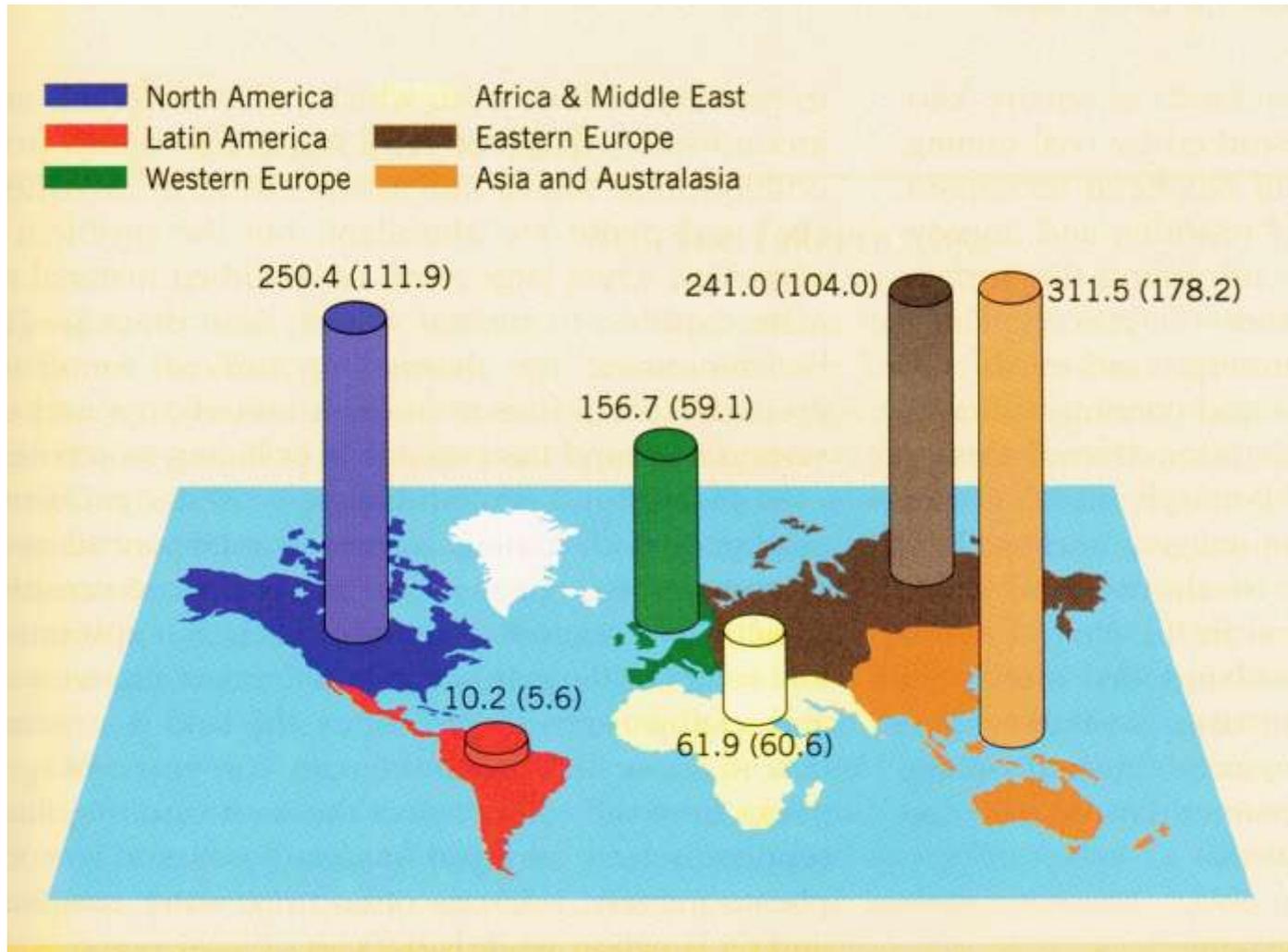


Coal



**Extraction of brown coal,
Germany**

Explored coal and lignite resources in the World, *billions ton*



Extraction of the coal in a open mine





Coal fired power plants provide 49 % of consumed electricity in the United States. Castle Gate Plant, Utah.

Coal



Chinese coal miners in an illustration of the *Tiangong Kaiwu* encyclopaedia, published in 1637.

At present, the most thorough assessment was carried out in 2006, stating that coal resources suitable for energy production amount to 1.081 trillion tons - thus, their energy value is equivalent to 4.789 billion barrels of oil.

Although coal is considered a widely distributed deposit and found in all continents, extraction is economically grounded and concentrated only in **four major countries**: the USA (27%), Russia (17%), China (13%) and India (10%). These countries provide ~65% of coal extraction in the world.

Aerial Image Of Kingston Ash Slide 12/23/08



Aerial photograph of Kingston Fossil Plant coal fly ash slurry spill site taken the day after the event.

The total explored world coal reserves comprised 795 billion tons in 2005.

There are a number of adverse health and environmental effects of coal burning especially in power stations, and of coal mining.

These effects include:

- coal-fired power plants shortened nearly 24,000 lives a year in the United States, including 2,800 from lung cancer,
- generation of hundreds of millions of tons of waste products, including fly ash, bottom ash, flue gas desulfurization sludge, that contain mercury, uranium, thorium, arsenic, and other heavy metals,
- acid rain from high sulphur coal,
- interference with groundwater and water table levels.



PEAT

PEAT

Peat is black, brown or yellowish-brown sedimentary rock which, when dry, consists of over 50% organic substances. It is formed of plant material at different stages of decomposition, having accumulated in extremely wet conditions.



Extraction of the peat at the Cenās bog, Latvia

In Latvia peat bogs and several wet forest types on peaty soils (thickness of the peat layer exceeds 30 cm) cover 10.4% of the country's territory.

At present the territory of peat extraction comprises 0.4% of the country's territory, with about 25% of the available peateries.

PEAT

According to historical data, peat extraction has fundamentally changed throughout the world in the last century.

After World War I, peat extraction amounted to slightly less than 15 million tons a year.

In the 1930s this figure grew to 31 million tons, while the development of agriculture caused a rapid rise at the end of the 1950s and after the first oil crisis in 1974.

The last peak – 370 million tons of air-dry peat a year – was the absolute maximum, which persisted for almost a decade.

After that peat extraction became economically unprofitable as oil products and, since the 1980s, also natural gas were cheaper and more easily available.

Thus, since the mid-1990s, the world peat extraction has only slightly exceeded the amount extracted in the early years of the 20th century.



Industrial milled peat production in a section of the Bog of Allen in the Irish Midlands. The *turf* in the foreground is machine produced for domestic use.

PEAT

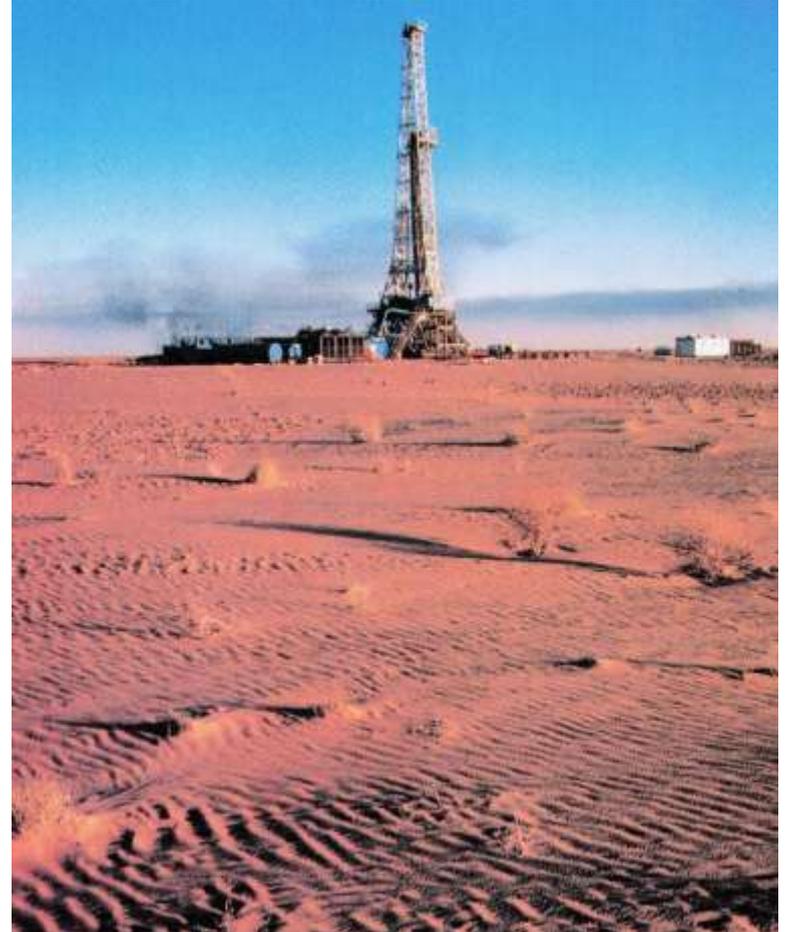


The Toppila Power station, a peat-fired facility in Oulu, Finland

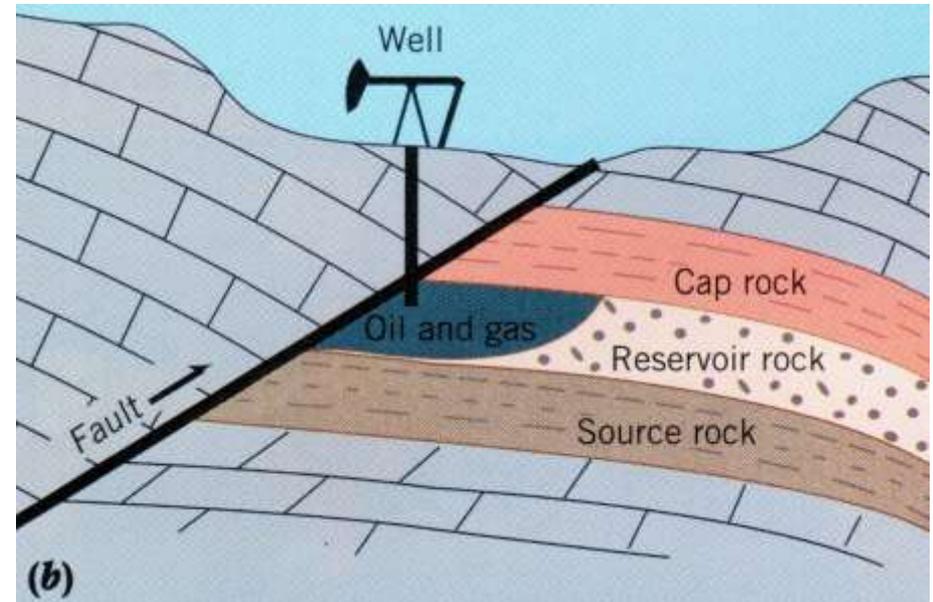
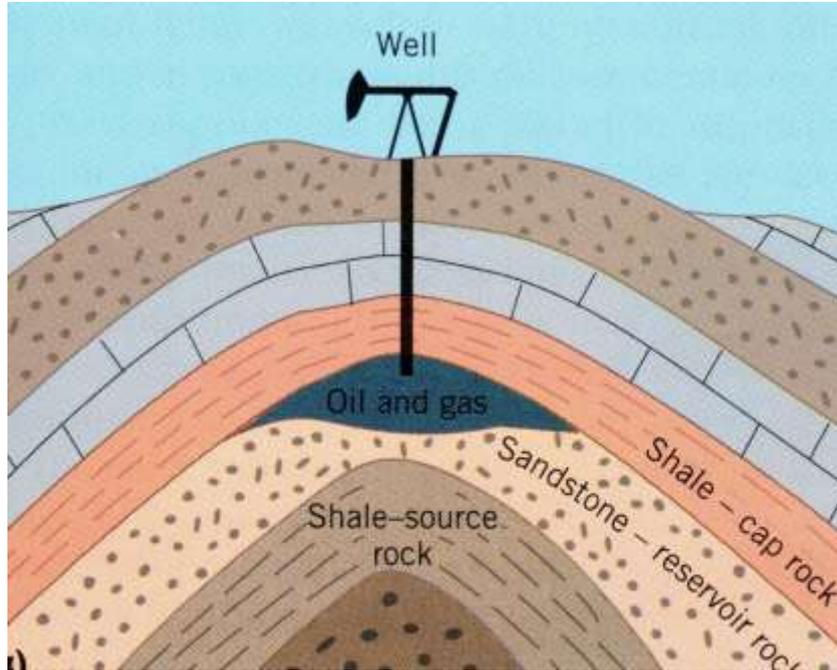
Today most peat goes to seed farms to propagate seedlings for forests, parks and gardens.

Peat is extracted for commercial purposes, and just over 800 companies extract more than 95% of the total amount to produce approximately 55 million tons of air-dry peat a year.

OIL



Oil location underground





An oil refinery in Mina-Al-Ahmadi, Kuwait



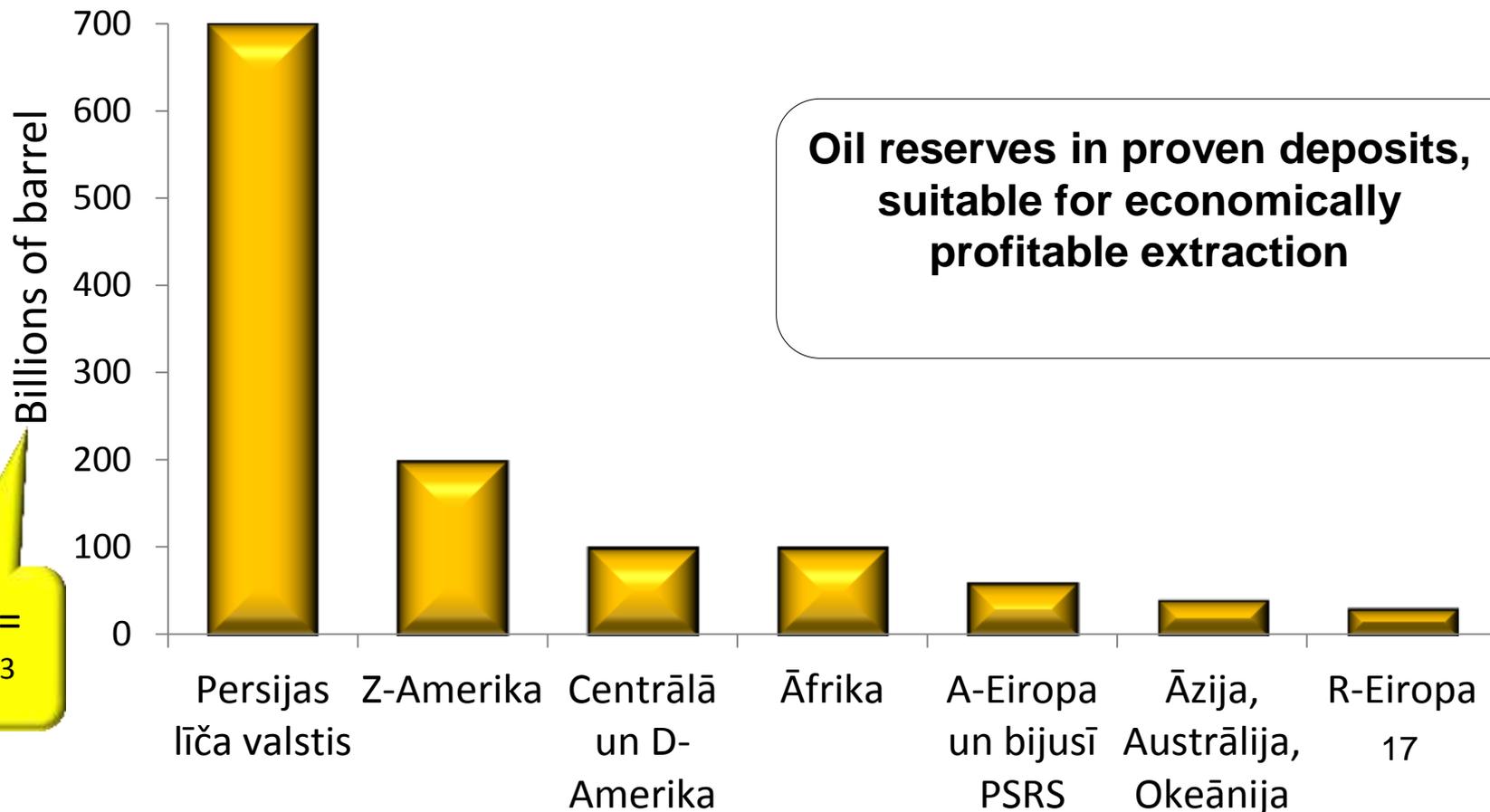
Pumpjack pumping an oil well, Texas.

OIL

In nature oil is a liquid that fills in empty spaces, crevices and caverns in rocks, forming deposits in anticlines, folds at plate boundaries and foothills.

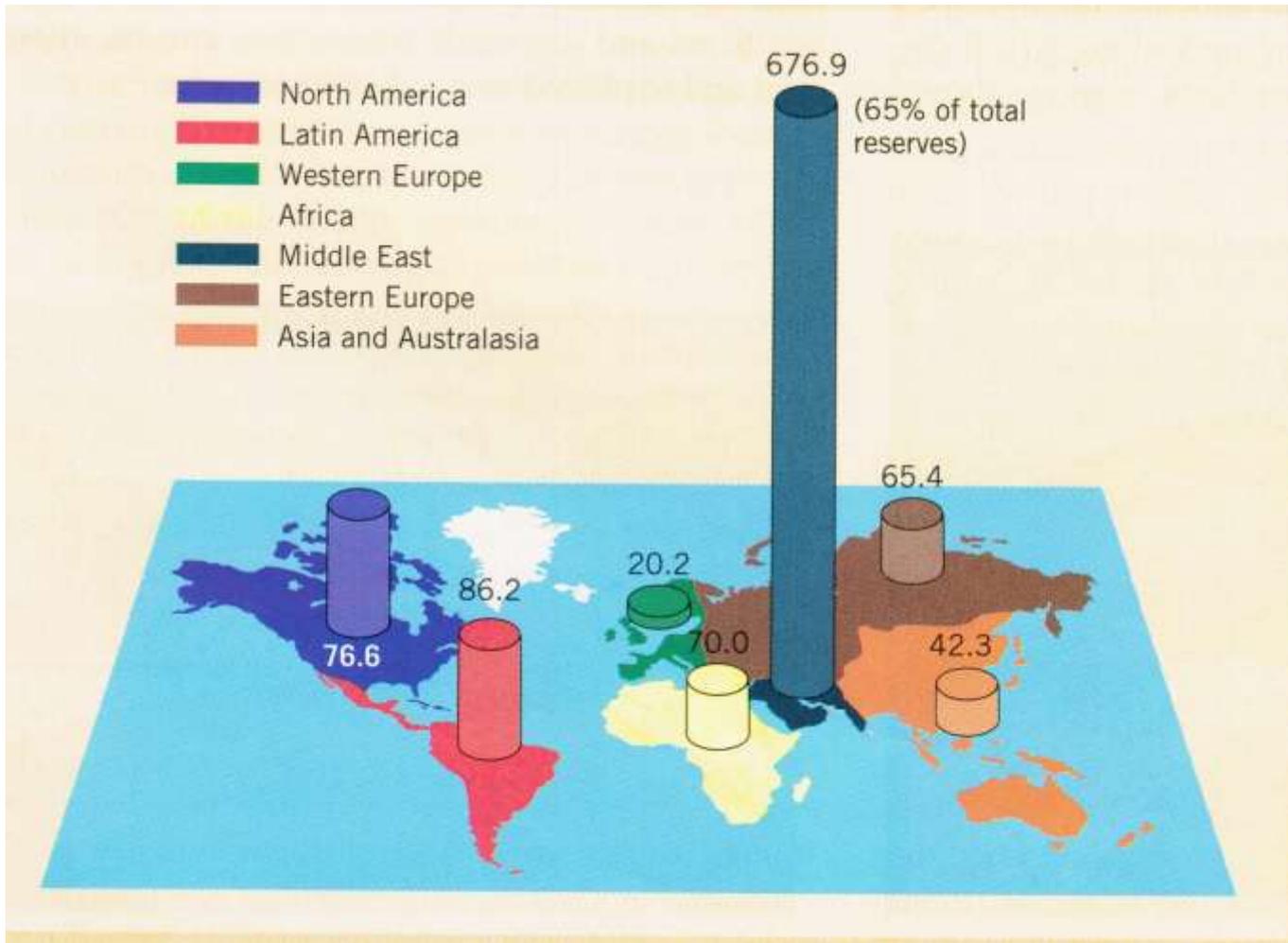
Oil can also be found in pores or on grains of rocks. Such oil can form oil-saturated sandstone and limestone rocks, or plastic and hard layers of crust, most often called natural asphalt or oil shale.

In the Earth liquid oil is usually buried to the depth of 0.3–5 km; when deeper, it can be found only as admixture in deposits of natural gas.

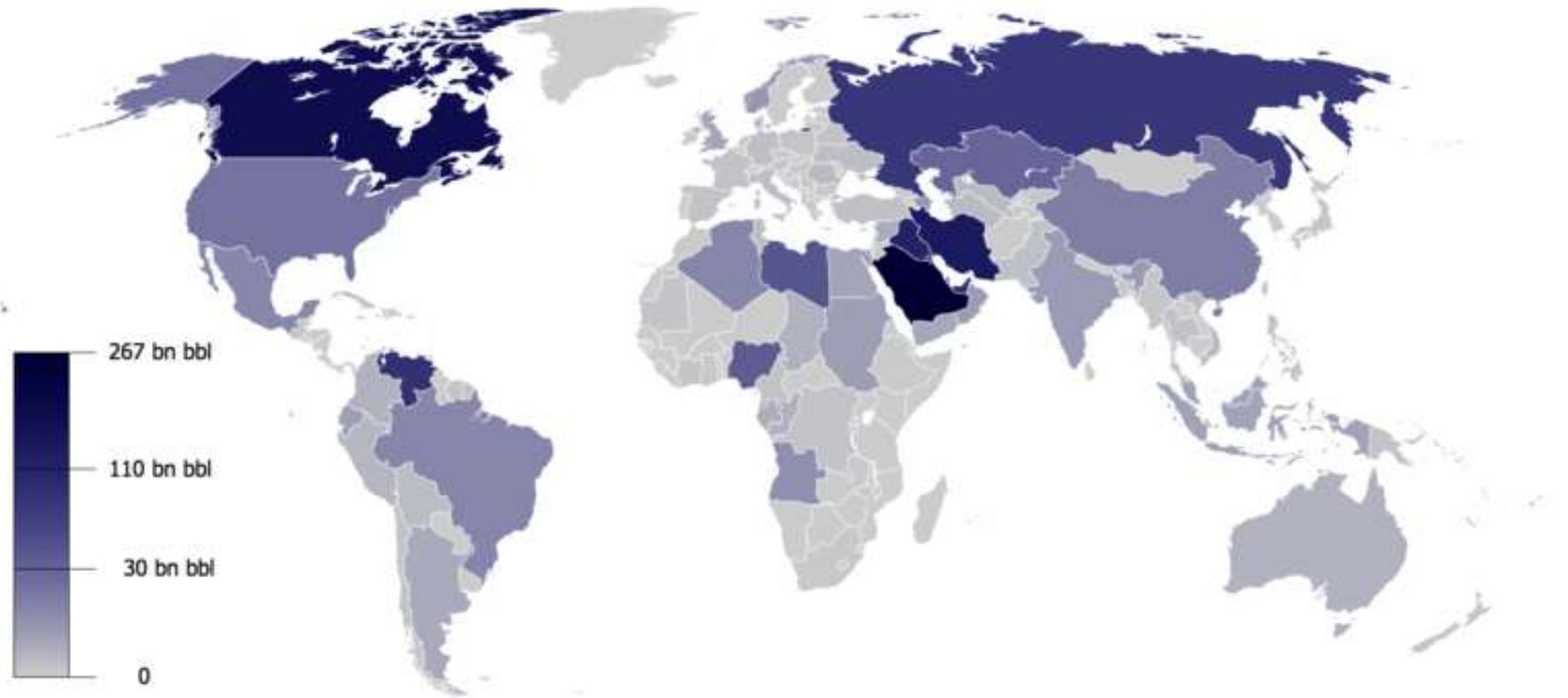


1 barrel =
~0,16 m³

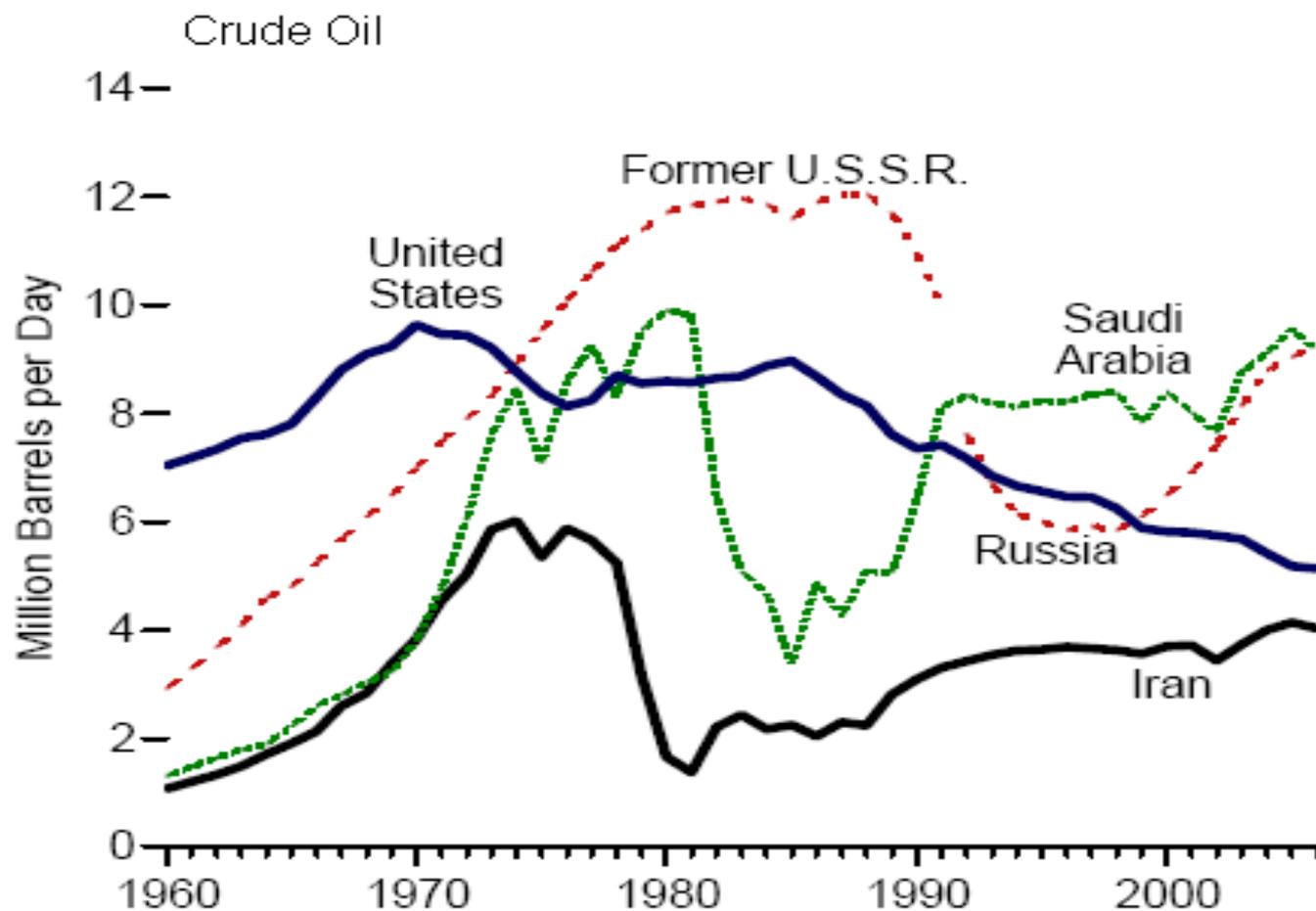
World oil reserves, *billions of barrel*



Proven world oil reserves, 2009

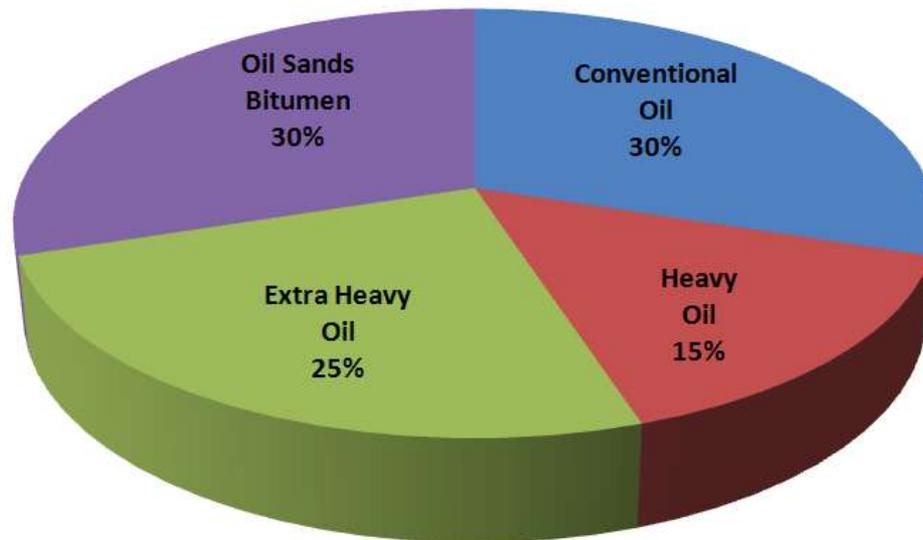


Top Producing Countries, 1960-2006



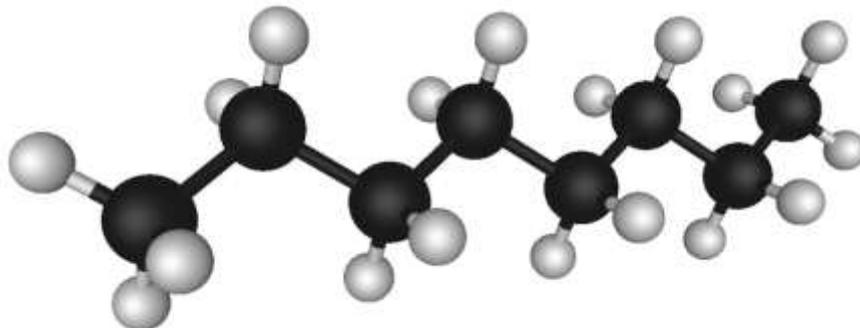
Source: US DOE, Energy Information Administration
Annual Energy Review 2006

Total World Oil Reserves

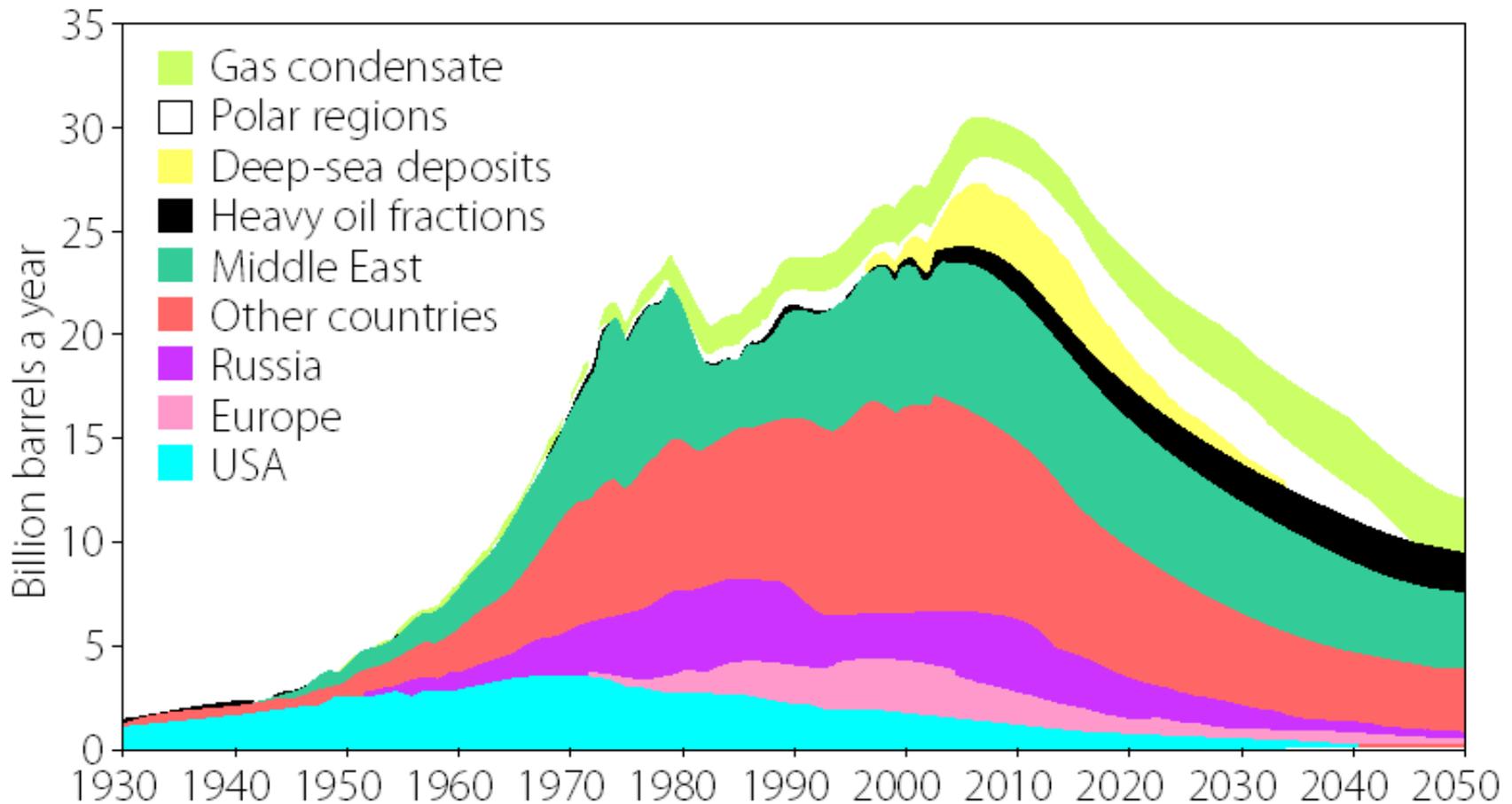


Octane, a hydrocarbon found in petroleum.

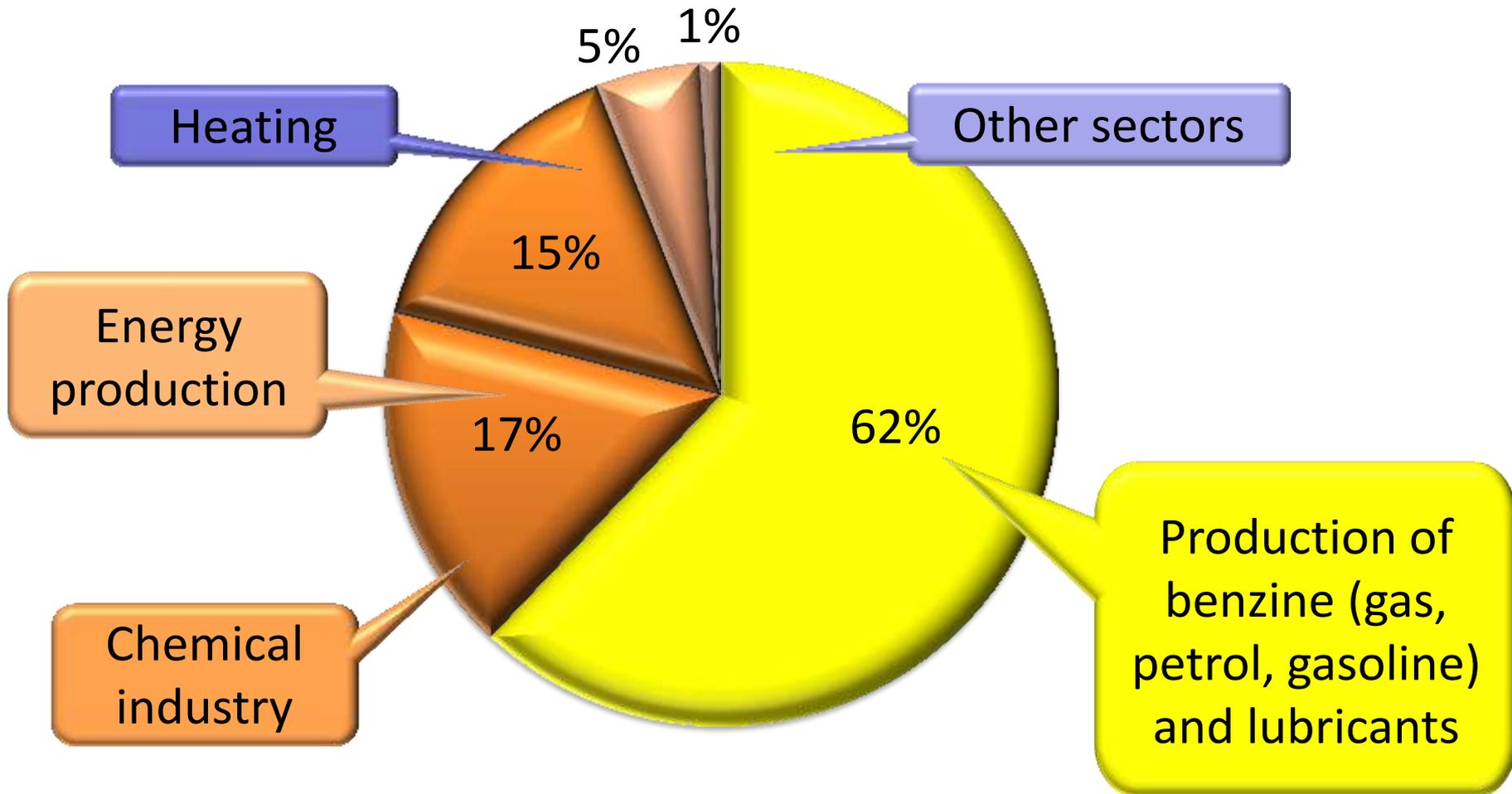
Lines represent single bonds; black spheres represent carbon; white spheres represent hydrogen.



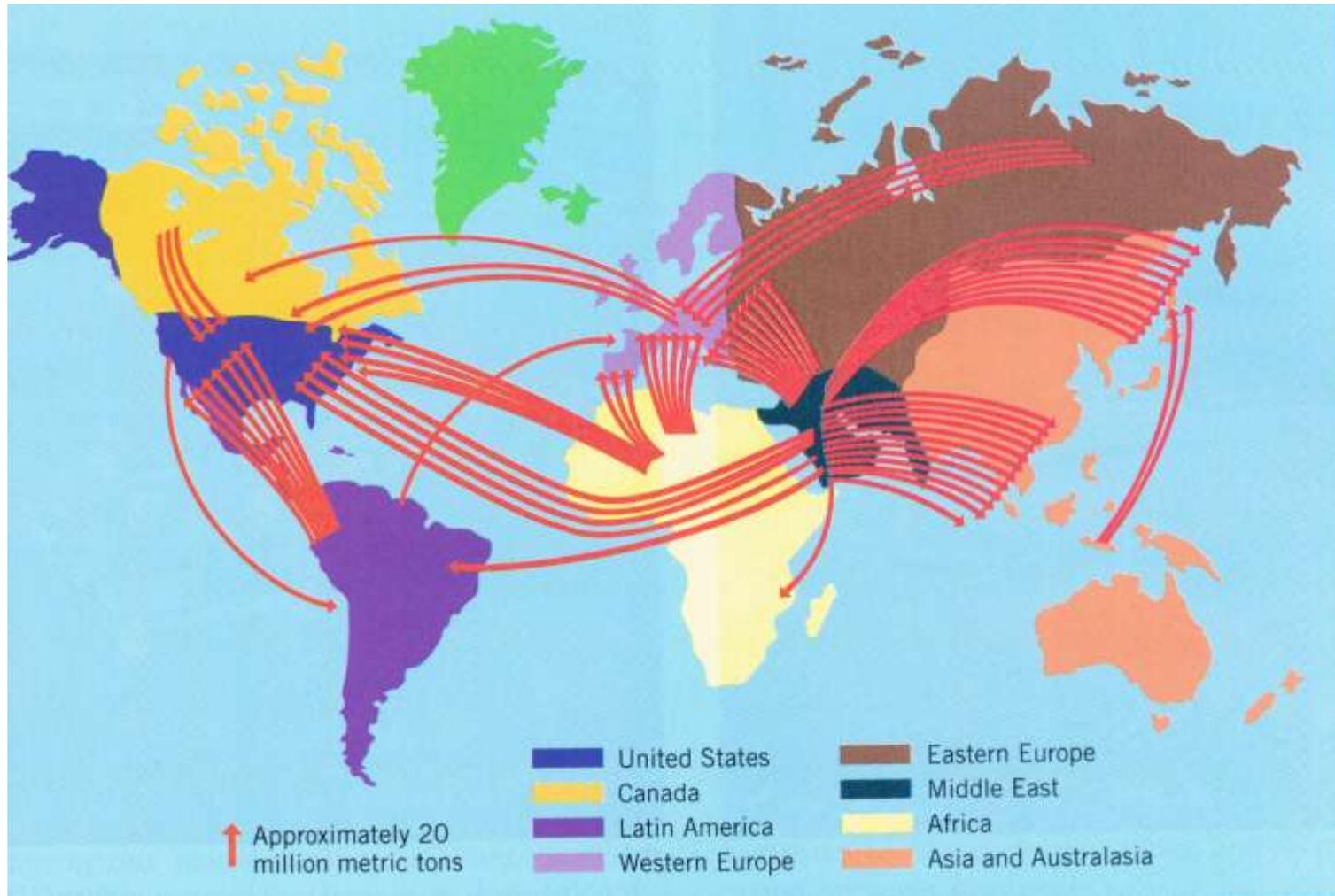
Forecast of oil extraction and consumption



Use of oil



Main oil trade routes in the World





Diesel rainbow

Diesel fuel spill on a road



Volunteers cleaning up the aftermath of the "Prestige" oil spill



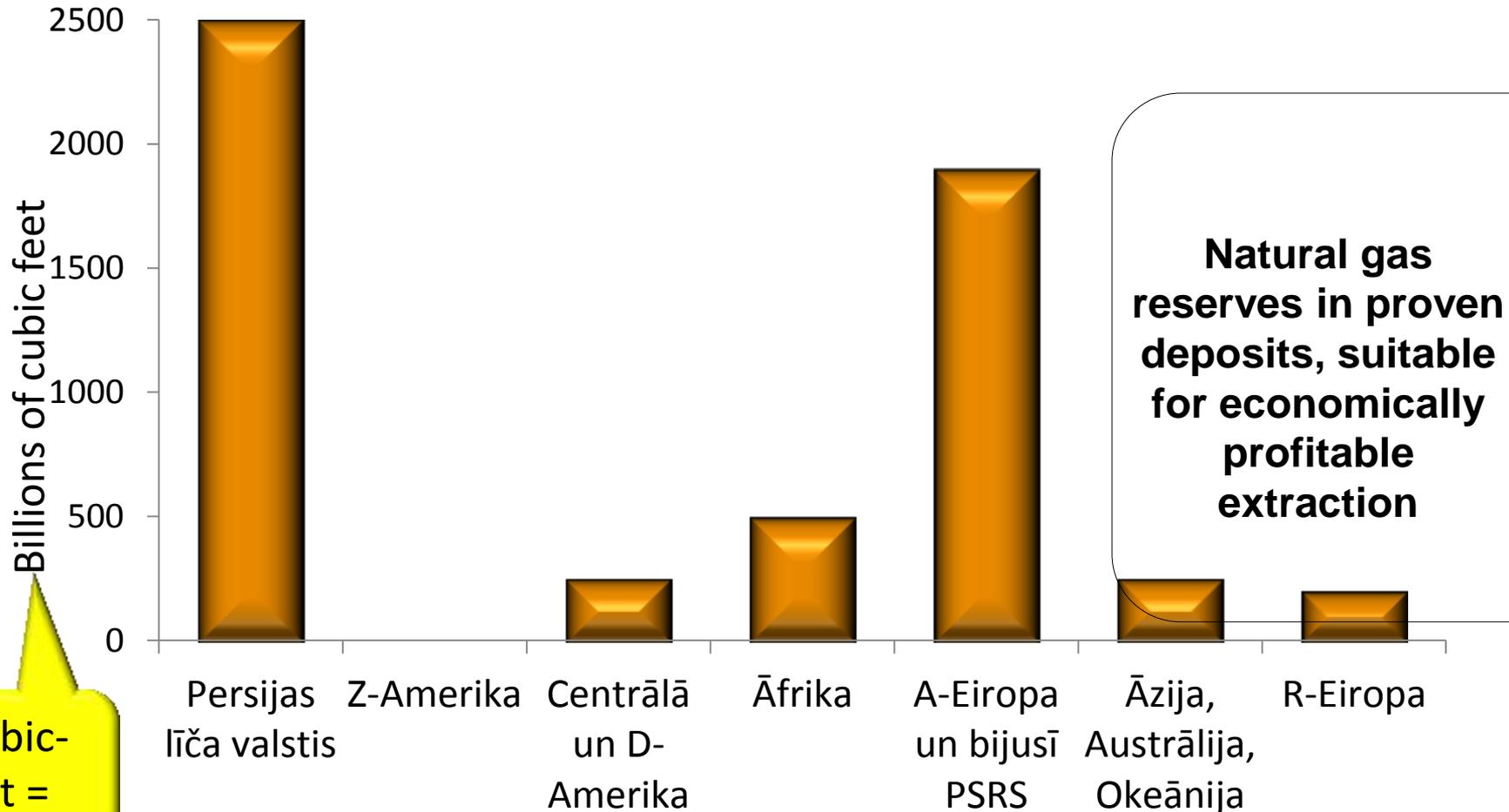
Natural gas

Natural gas

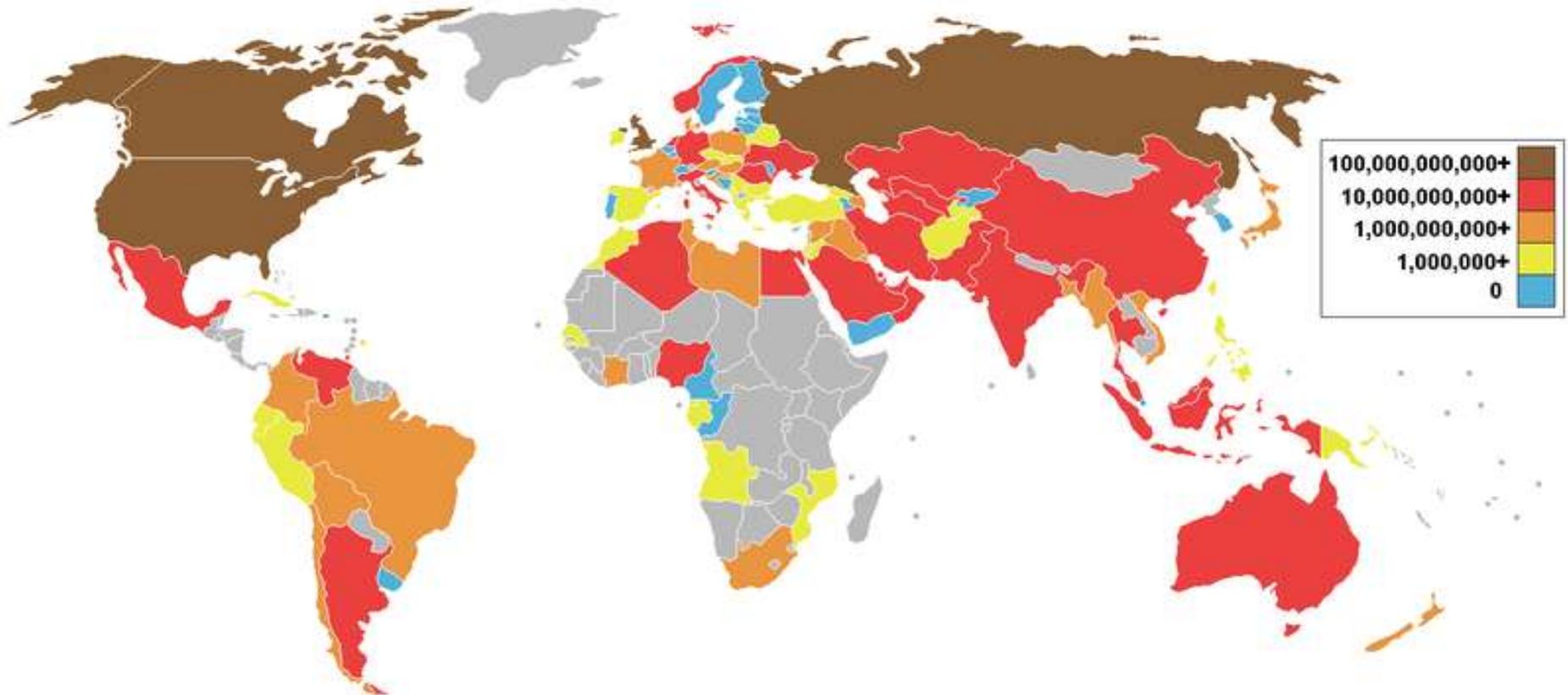
At present deposits at the depth of 100 metres to 9.15 kilometres have been explored and are used or are being prepared for use.

Their area varies from several tens of hectares to hundreds of square kilometres.

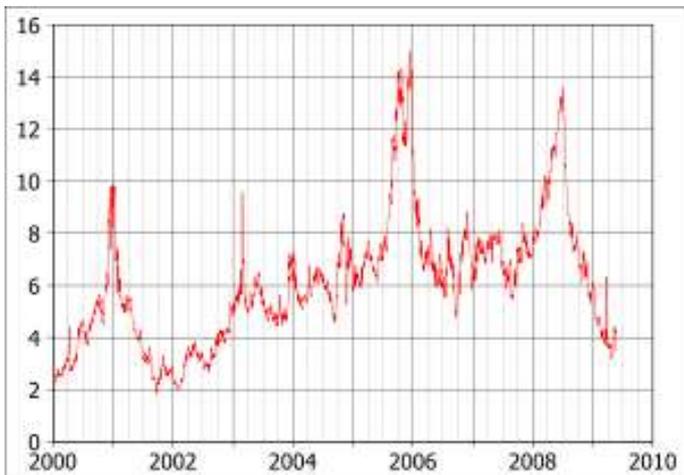
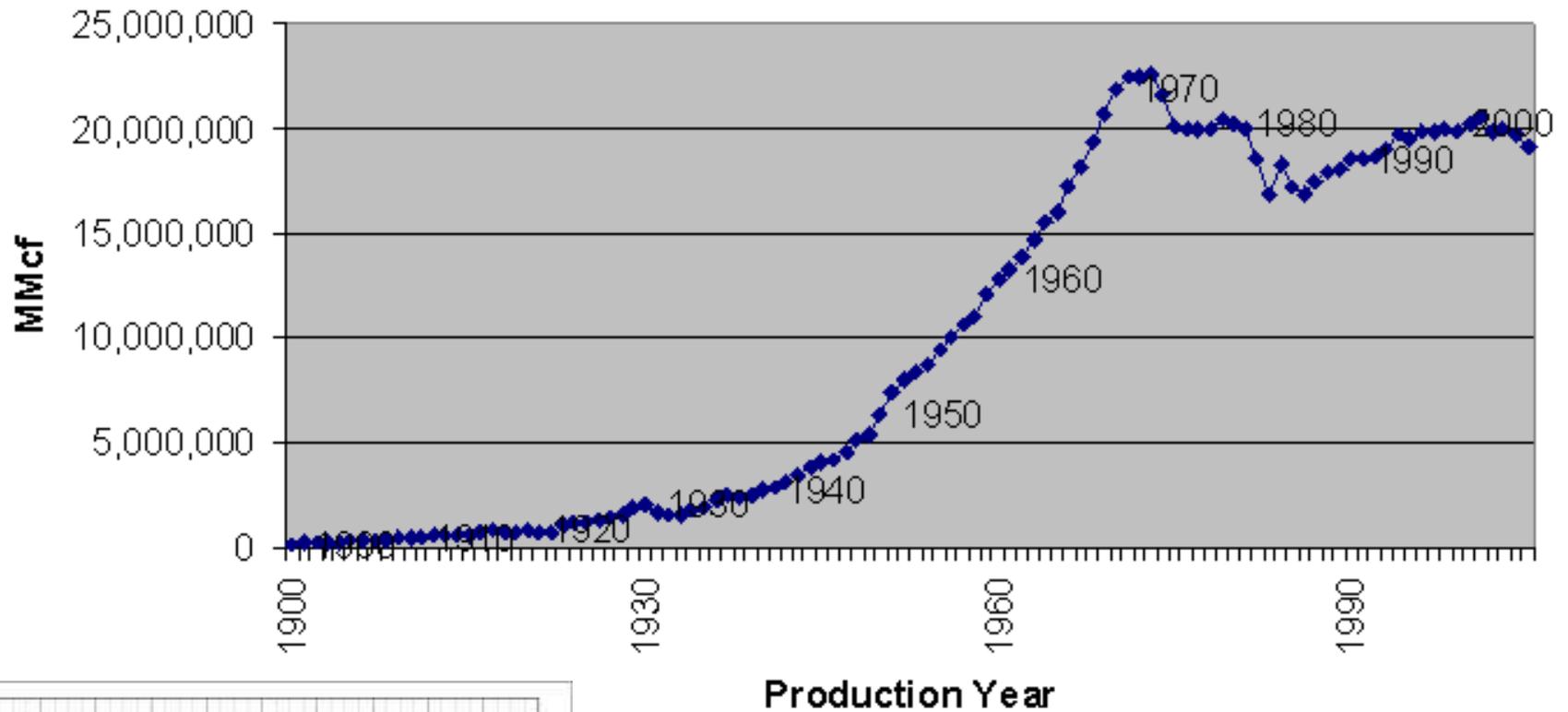
The estimate of exploitable gas deposits is 6 112.144 trillion cubic feet.



Natural gas extraction by countries in cubic meters per year



United States of America Natural Gas Extraction



**Natural gas prices in US dollars
per million BTUs - British thermal units,
(\$/mmbtu) for 2000-2010.**



Natural gas drilling in Texas



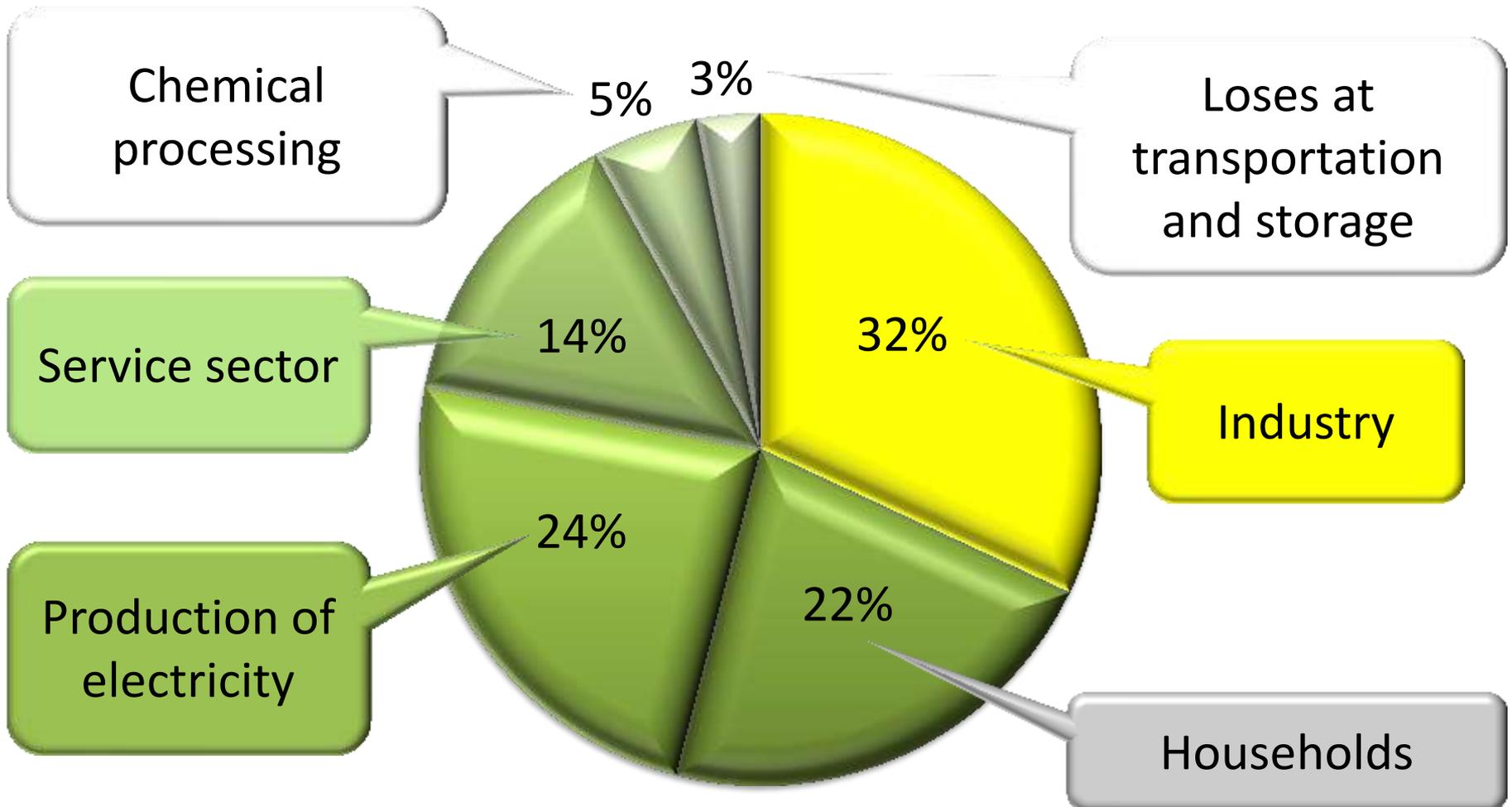
The natural gas processing plant in British Columbia, Canada



A Washington, D.C. "Metrobus", which runs on natural gas.

Natural gas

Use of the natural gas



Gas-exporting countries

Since the beginning of the new millennium, the role of the major gas-exporting countries in the global market has essentially changed compared to the previous decades.

In recent years **Russia has exported 25%** of the world gas reserves, the **USA 22%**, **Canada 7%**, the **United Kingdom 4%**. Algeria and the Netherlands export smaller amounts, while the share of other countries amounts to less than 1%.

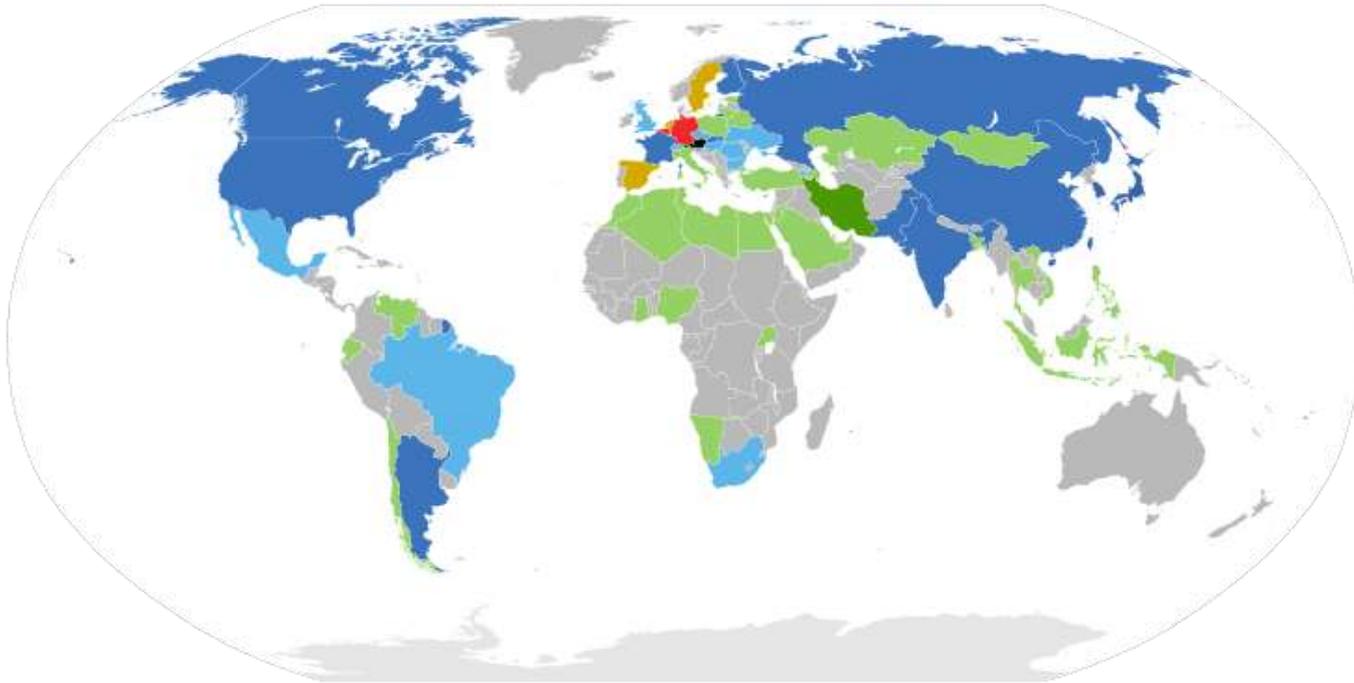
It is noteworthy that the USA, Canada and the United Kingdom also are the biggest natural gas importers, which is yet another aspect of globalisation of the modern world.

Nuclear power



Three nuclear powered ships, (top to bottom) nuclear cruisers USS Bainbridge and USS Long Beach with USS Enterprise the first nuclear powered aircraft carrier in 1964. Crew members are spelling out Einstein's mass-energy equivalence formula $E = mc^2$ on the flight deck.

The status of nuclear power globally



As of 2005, nuclear power provided **6.3% of the world's energy and 15% of the world's electricity**, with the US, France and Japan together accounting for 56.5% of nuclear generated electricity. As of December 2009, the world had **436 reactors**. Annual generation of nuclear power has been on a slight downward trend since 2007, decreasing 1.8% in 2009 to 2558 TWh with nuclear power meeting 13–14% of the world's electricity demand.

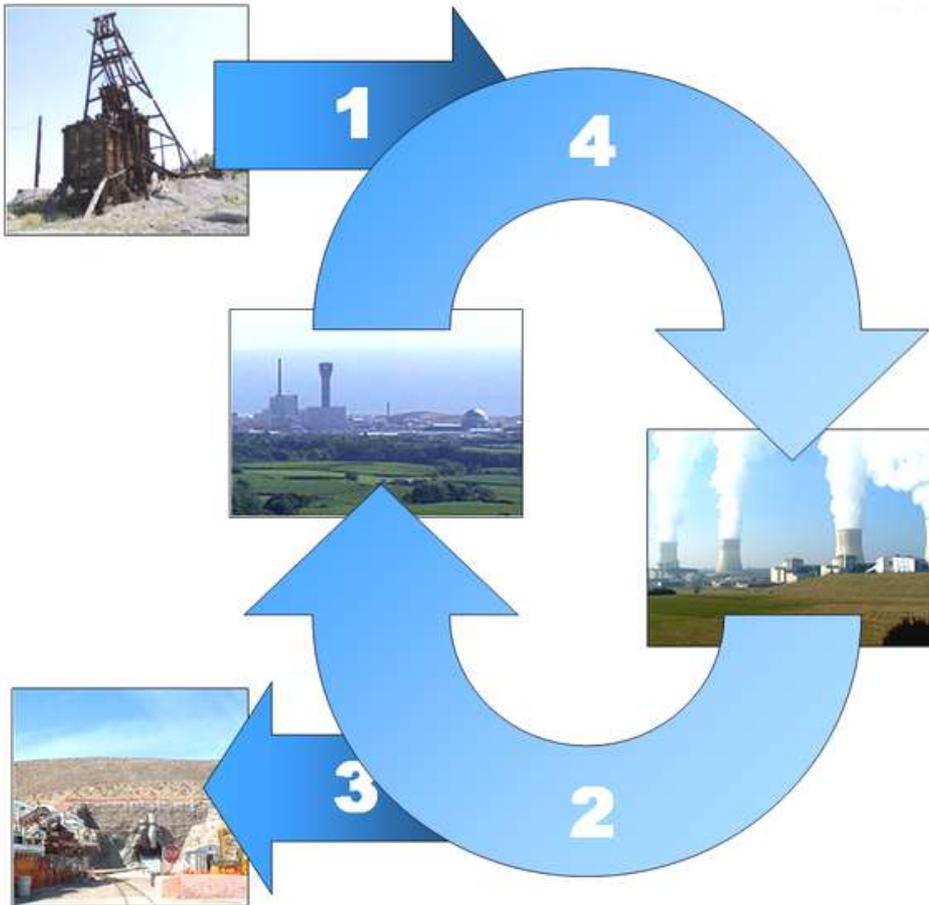
The United States produces the most nuclear energy, with nuclear power providing 19% of the electricity it consumes, while France produces the highest percentage of its electrical energy from nuclear reactors—80% as of 2006.

In the European Union as a whole, nuclear energy provides 30% of the electricity.

Nuclear energy policy differs among European Union countries, and some, such as Austria, Estonia, Lithuania, Latvia and Ireland and Italy have no active nuclear power stations. In comparison, France has a large number of these plants, with 16 multi-unit stations in current use.

In the US by 2013 nuclear power generators are forecast to be worth \$18 billion.

Nuclear fuel cycle



The nuclear fuel cycle begins when uranium is mined, enriched, and manufactured into nuclear fuel, (1) which is delivered to a nuclear power plant.

After usage in the power plant, the spent fuel is delivered to a reprocessing plant (2) or to a final repository (3) for geological disposition.

In reprocessing 95% of spent fuel can be recycled to be returned to usage in a power plant (4).

URANIUM ORES

The first nuclear reactors were created to produce plutonium for nuclear weapons, and it was only in the mid-1950s that the first projects of nuclear reactors were developed for non-military purposes. The first commercial nuclear power plant came into operation in 1956, and further construction of nuclear power plants and reactors expanded fast until the Chernobyl accident.

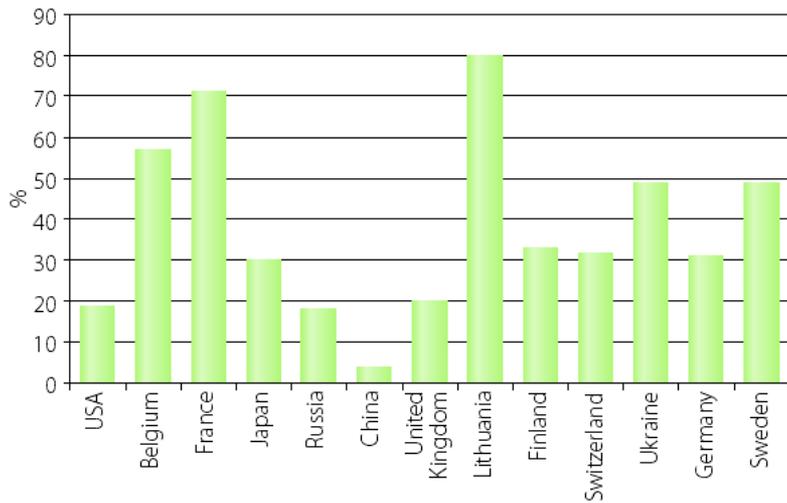
At present in the world over 400 nuclear reactors produce electricity (apart from the reactors for military purposes).



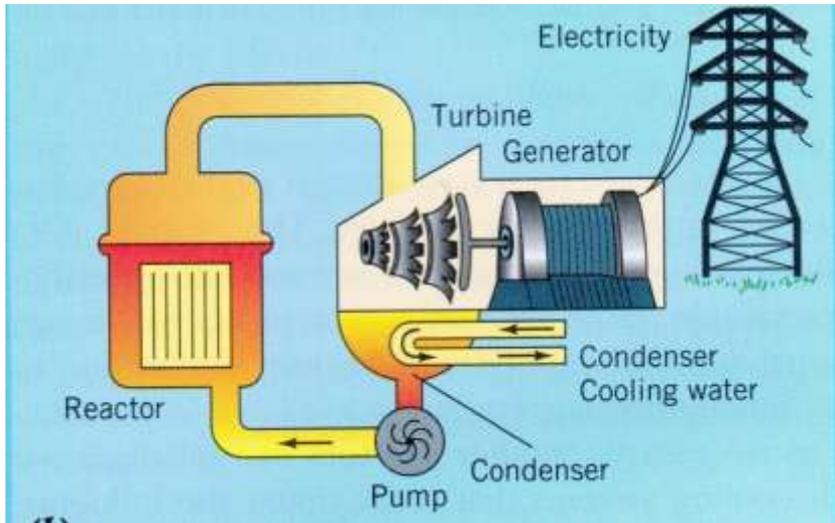
“Greenpeace”
protest action
at nuclear
reactor in
Belgium



Radioactive waste



The share of nuclear energy in electricity production in countries



Conversion the nuclear energy in electric energy



Nuclear Power plant in Leibstadt, Switzerland

Nuclear energy

In 2006, 61 countries extracted uranium, however, uranium extraction has decreased in many countries because of the overproduction of the ore.

Although the actual amount of the exploited nuclear energy sources is on the increase, only some of the raw material is mined; instead, reserves of nuclear weapons are being intensively reprocessed (65% of the total amount of sources).

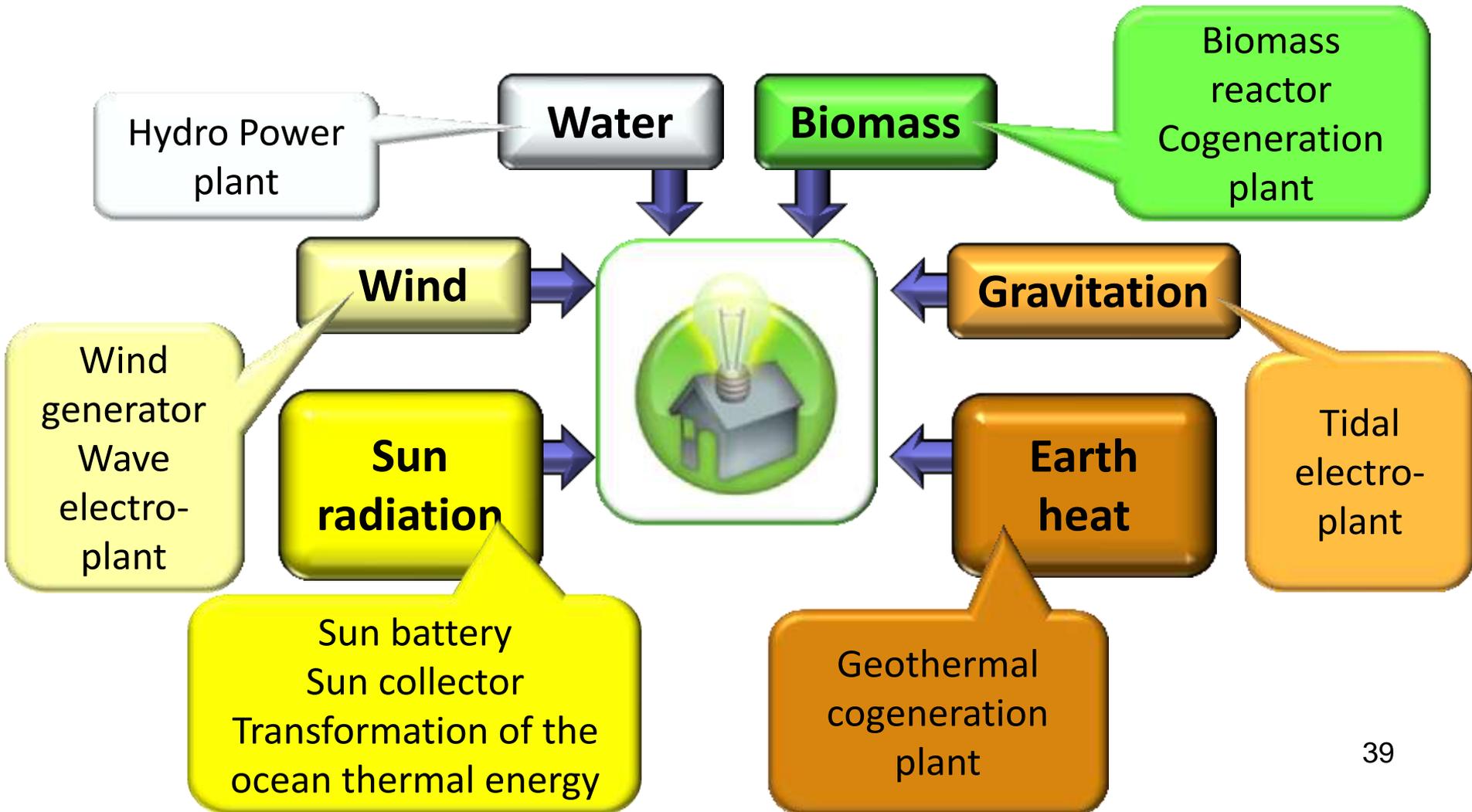
These energy sources have an essential impact on the competitiveness of the mining industry, but it is estimated that they will have been reprocessed by 2020.

In 2005, the volume of mined uranium ore amounted to **40 251 tons** (converted into pure uranium), most of it in Canada (28.8% of the total world uranium extraction).

On average, nuclear power produces 17% of the world's electricity, and since 1990 its role has changed little.

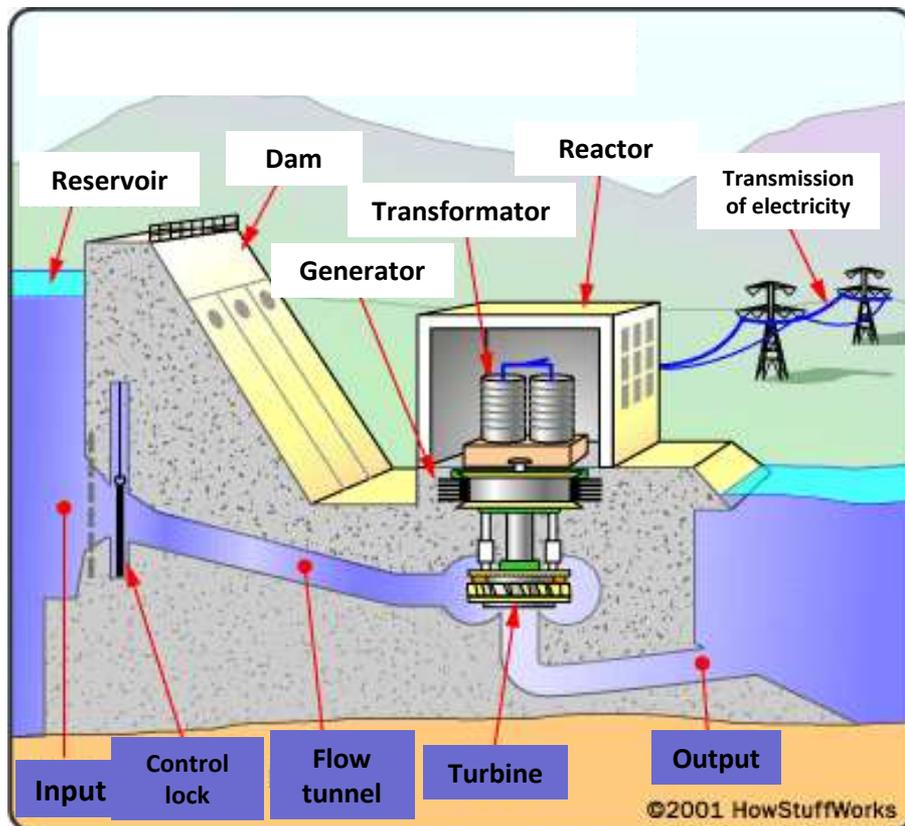
In the European Union countries nuclear power used for electricity generation comprises about one-third of the total amount of energy, but in several member states it constitutes over 60%, and there is no reason to believe that the consumption of nuclear energy might decrease in the future.

RENEWABLE ENERGY RESOURCES



ELECTRICITY FROM HYDROELECTRIC POWER PLANTS

Today only 20–25% of the hydropower potential of big and small rivers is used in Latvia. However, the construction of reservoirs for hydroelectric plants is usually connected with inundation of river valleys, which may cause destruction of many rare and unique biotopes.



Hydro Power plant

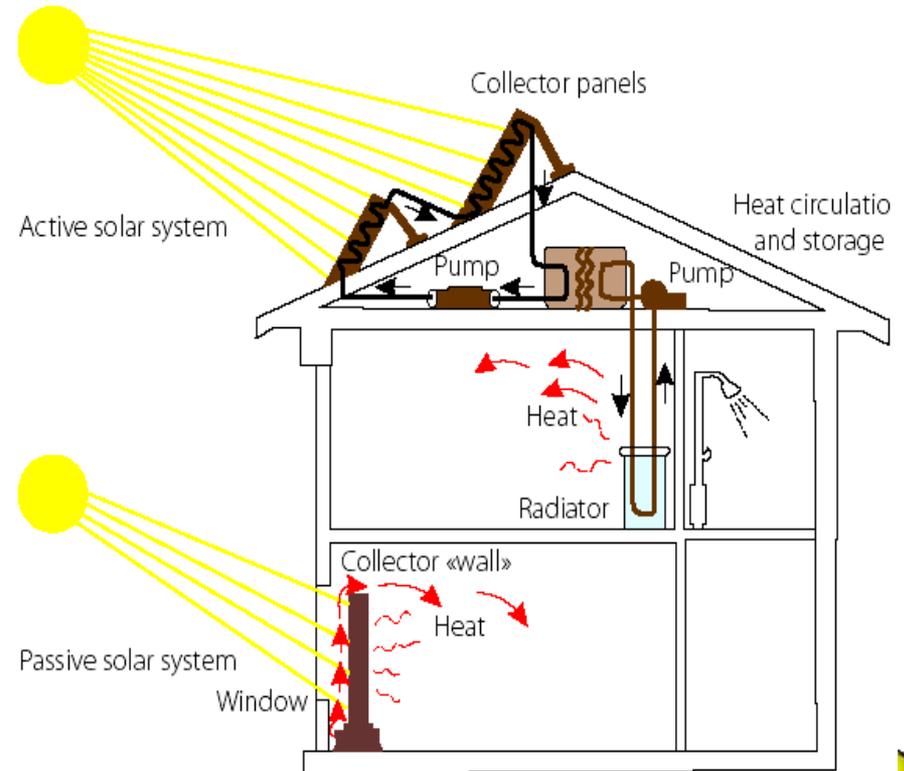
Dams of hydroelectric plants hamper migration of fish, while the work of turbines creates frequent fluctuations of the water level and downstream flow during low water periods, thus influencing water and coastal ecosystems.

SOLAR ENERGY

Solar energy is the most widely available resource on the Earth.

In an hour the surface of the Earth receives nearly the same amount of energy that the whole humanity consumes in a year.

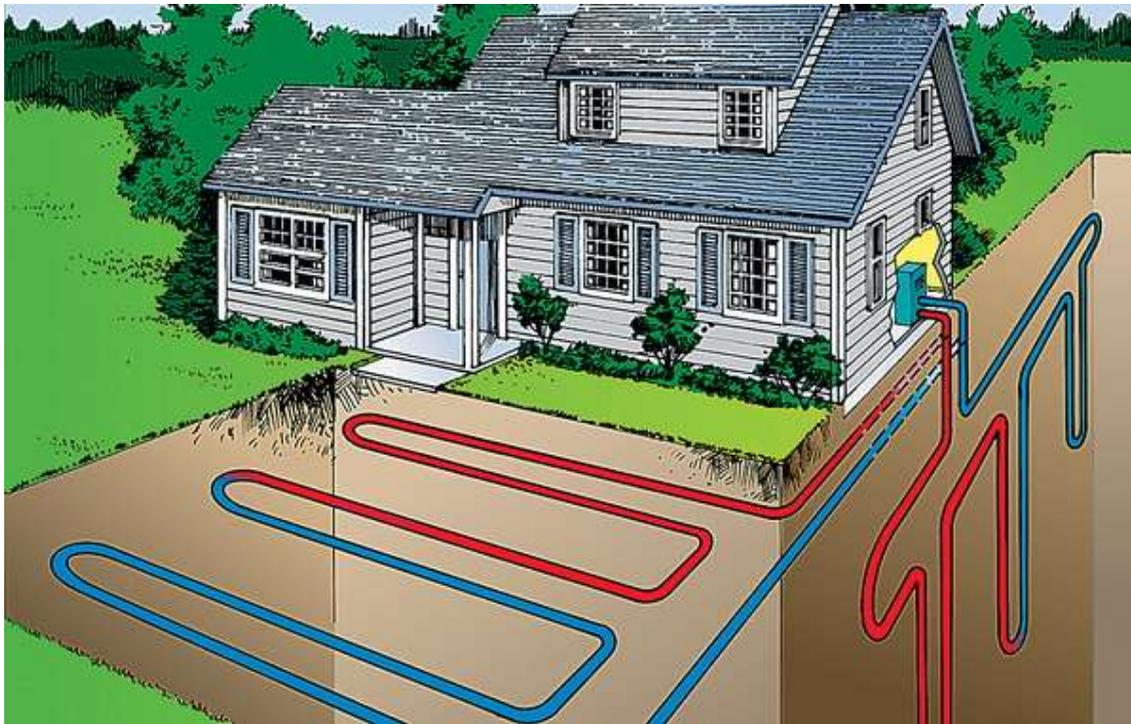
More intensive use of solar energy is limited by the costly technologies and their insufficient ability to absorb solar radiation, especially in the regions where the flow of solar radiation is less intensive.



Use of the solar energy for building heating

GEOTHERMAL ENERGY

Heat in the interior of the Earth originated during the evolution of our planet, and it is being constantly replenished by the decay of radioactive elements.



Heating of the buildings by heat pump

The use of geothermal energy is particularly topical in geologically favourable areas, mainly at the tectonic boundaries of plates (for example, in Iceland).

WIND ENERGY

Wind arises due to the Earth's rotation and differential warming of its surface. The role of wind the world energy production is rapidly growing.

The farther off the surface of the Earth, the stronger is the wind; this is why turbines should be built to the height of at least 120–150 m.

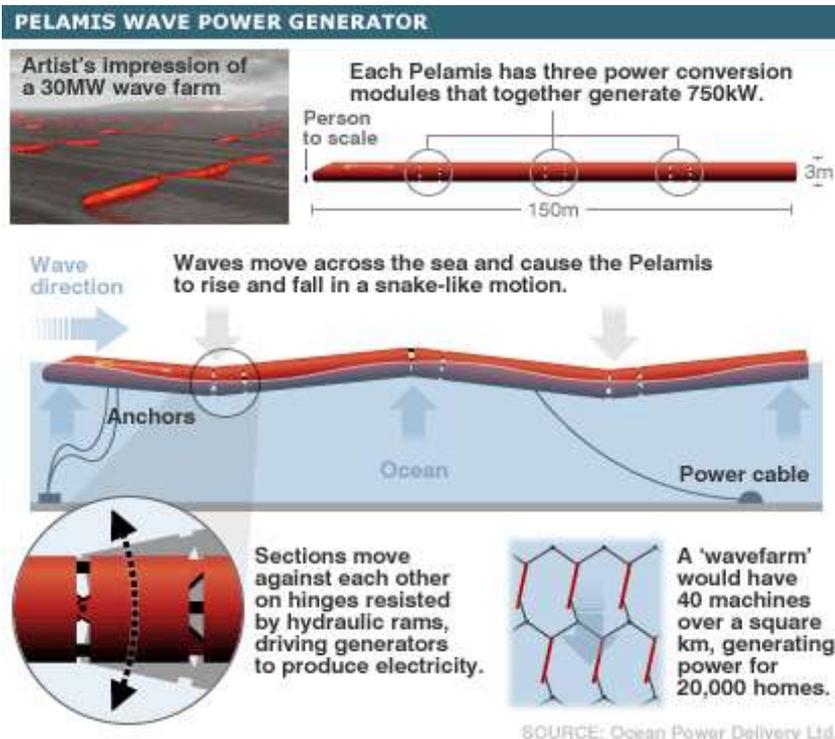
- According to a US estimate, a wind power capacity of 1 MW will annually diminish:**
- carbon dioxide emission into the atmosphere by 1 500 tons,
 - sulphur dioxide by 6.5 tons;
 - nitric oxides by 3.2 tons.



Non traditional wind generator

OCEAN WAVE POWER

Electricity can be produced by exploiting the kinetic energy of the ocean and sea waves.



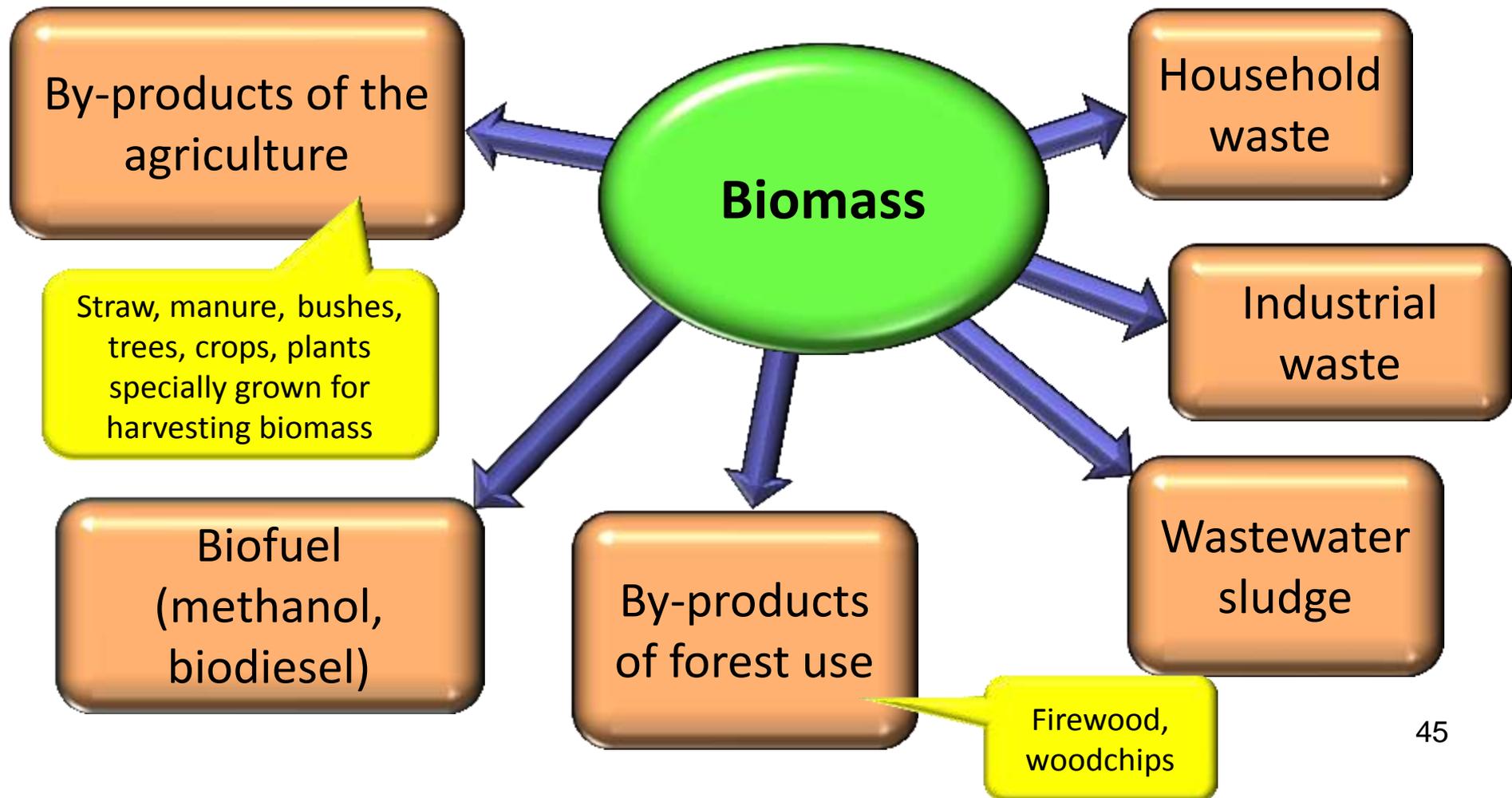
If a one-metre high and 25-metres long wave crashes against the coast, the amount of the released energy is approximately 120 kilojoules.

Converted into electricity, it would provide enough energy to light a table lamp for one hour.

Wave Power Generator

BIOMASS ENERGY

Biomass is the biologically degradable part of waste and residue (including plant matter and animal waste) of agriculture, forestry and related industries, as well as the biologically degradable part of industrial and household waste.



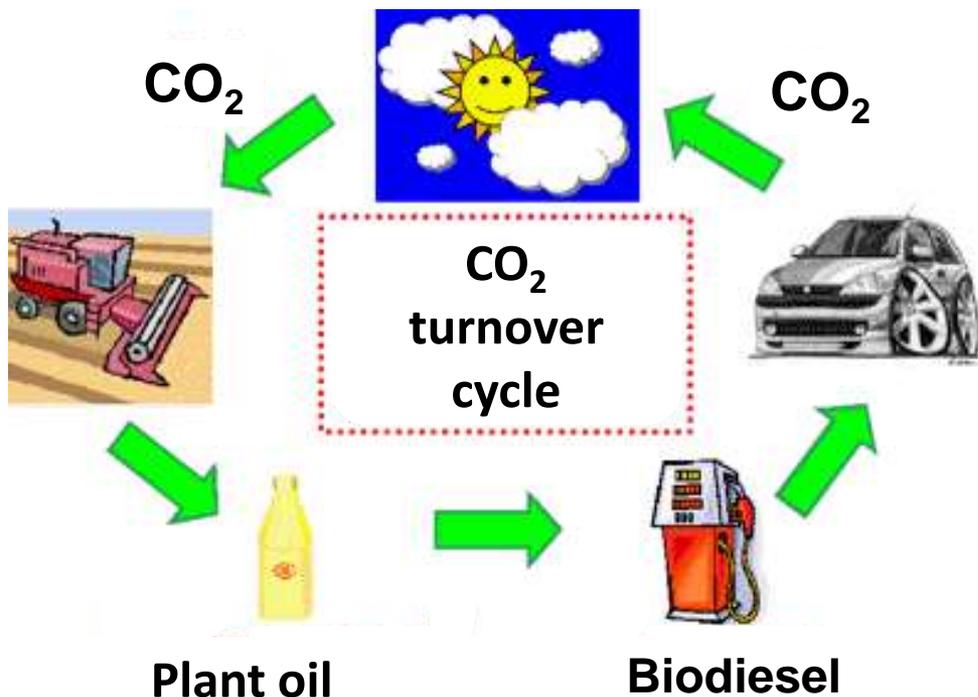
BIOMASS ENERGY

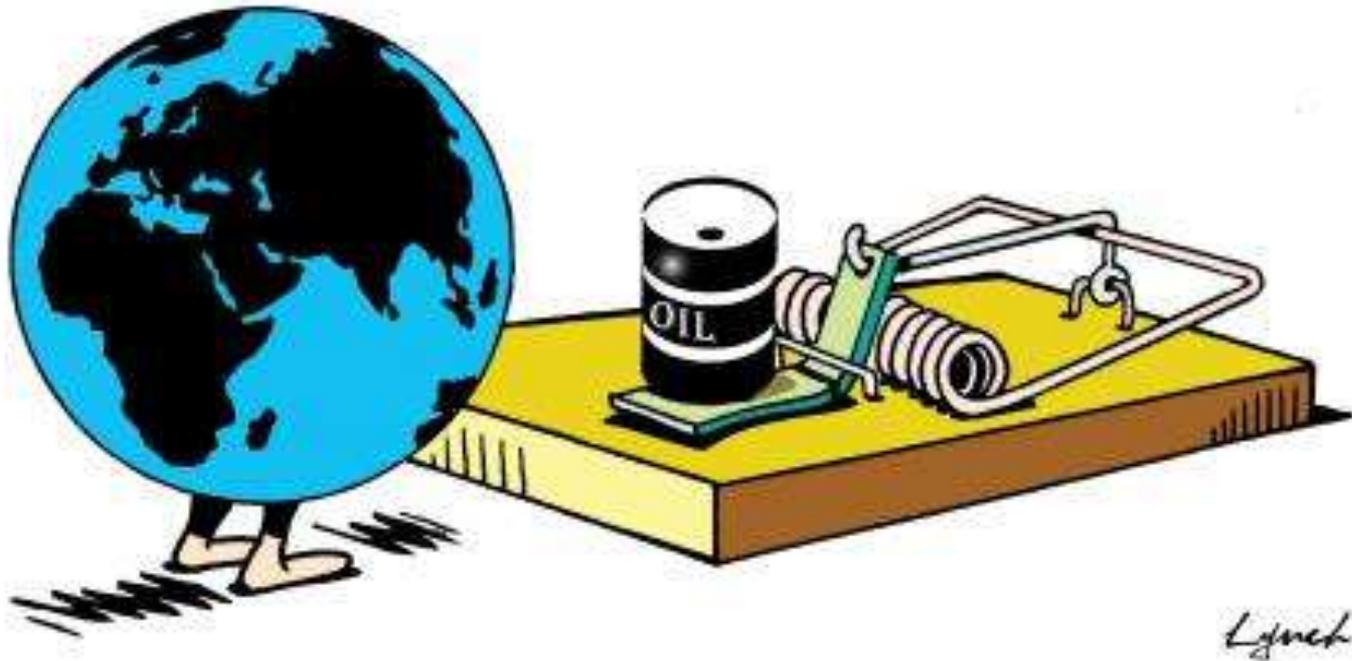
The most important type of biofuel is biodiesel, produced by esterification of vegetable oils, for example, soya oil, with alcohol (methyl alcohol, ethyl alcohol).

Production of biodiesel is waste-free, and the eventual by-products – oil cakes, glycerol, sodium or potassium phosphates – can be further used in various other industries.

Production and use of biodiesel (a rapeseed oil methyl ester) is rapidly developing in the EU Member States because the EU directives stipulate that the consumption of biofuel should grow by 0.75% a year and should reach no less than 5.75% of the total consumption of vehicular fuels.

**Role of the biomass
for reduction of CO₂
emission**





THANK YOU FOR ATTENTION !