Producing Power

Students use the terms provided to complete the cloze activity.

Information from the:

- Carbon Capture and Storage
- Oxy-fuel Combustion
- Post-combustion Capture
- Pulverised Fuel Combustion and
- Supercritical Conventional Coal Plants

factsheets will be useful in completing this task.

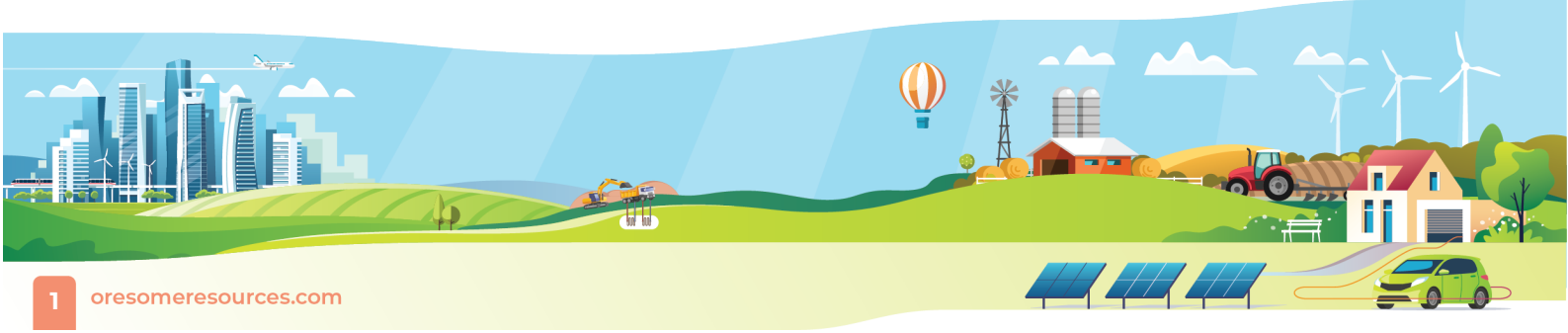
A list of terms to be used is located on page 2.

In a pulverised fuel power station, _____ coal is blown into a boiler with ____. The increased surface area of the coal _____ the reaction rate as coal is combusted. Superheated _____ produced through this process is used to drive _____ and generate electricity. At present, Australia has over forty _____ dollars invested in pulverised fuel power stations, and will continue to rely on this power source beyond 2020. Increasing _____ of these power generators, and _____ of emissions from them is essential to ensure their use into the future.

A measure of the amount of useful _____ that can be extracted from a given amount of coal in a power plant is called its _____ efficiency. Most modern, pulverised fuel power plants have a thermal efficiency of about _____, an increase of about 33% since 1900. With the increase in thermal efficiency, there has also been a decrease in _____ _____ emissions.

Some advanced modern plants have increased their efficiency even further to _____ through the incorporation of specially developed _____ steels which allow the use of _____ and ultra supercritical steam to drive turbines. In Queensland, _____ supercritical power plants exist, the first of which was commissioned at Callide in 2001. Other plants are increasing their efficiency by also using higher temperatures and _____ in the combustion of coal. With further increases in _____, it is expected that thermal efficiency will reach 55%.

As a vast majority of the world's coal-fired energy is produced using _____ fuel, controlling emissions is important. Many technologies are employed by power stations to reduce _____. Fly ash is removed using _____ _____ or fabric filters. Oxides of sulphur are removed using flue gas _____ processes, and are used in



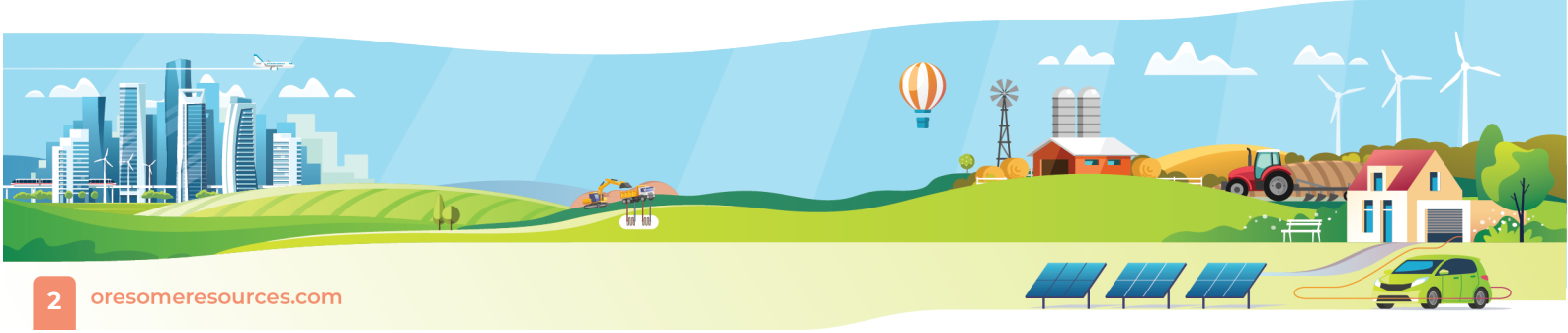
the manufacture of _____ for building needs. Nitrogen oxides are also removed from emissions through either selective _____ _____ or reburning.

Carbon dioxide produced during the _____ of fossil fuels can be _____ at the point of emission and stored underground using a process called carbon _____. Separated carbon dioxide can be stored in _____ formations including oil and gas reservoirs, unmineable coal seams, and saline formations, in _____ rock layers. The carbon dioxide is trapped by _____ overlying layers, ensuring relatively _____ storage underground. It can also be used in the creation of valuable ___-_____. Carbon sequestration is presently occurring in Australia and _____.

An alternative to the use of pulverized fuel power stations is ____-_____ combustion. The process involves feeding a _____ power station boiler with pure _____ rather than air, and _____ a proportion of flue gases. This increases carbon dioxide in _____ gas, making it easier to capture and store. This process is potentially applicable to Australia, as it would require only a ¬¬¬¬¬¬_____ of Australia's existing coal-fired power stations. CS Energy is presently implementing this technology at its _____ power station.

Terms to be used

- air
- alloy
- billion
- by-products
- carbon dioxide
- Callide
- captured
- catalytic reduction
- combustion
- desulphurisation
- efficiency
- electrostatic precipitators
- emissions
- energy
- flue
- four
- geological
- gypsum
- increase
- impermeable
- modified
- Norway
- oxy-fuel
- oxygen
- permeable
- powdered
- pressures
- pulverised
- recycling
- reduction
- retrofit
- safe
- sequestration
- steam
- supercritical
- technology
- thermal turbines
- 38%
- 45%



For Teachers - Answer

In a pulverised fuel power station, powdered coal is blown into a boiler with air. The increased surface area of the coal increases the reaction rate as coal is combusted. Superheated steam produced through this process is used to drive turbines and generate electricity. At present, Australia has over forty billion dollars invested in pulverised fuel power stations, and will continue to rely on this power source beyond 2020. Increasing efficiency of these power generators, and reduction of emissions from them is essential to ensure their use into the future.

A measure of the amount of useful energy that can be extracted from a given amount of coal in a power plant is called its thermal efficiency. Most modern, pulverised fuel power plants have a thermal efficiency of about 38%, an increase of about 33% since 1900. With the increase in thermal efficiency, there has also been a decrease in carbon dioxide emissions.

Some advanced modern plants have increased their efficiency even further to 45% through the incorporation of specially developed alloy steels which allow the use of supercritical and ultra supercritical steam to drive turbines. In Queensland, four supercritical power plants exist, the first of which was commissioned at Callide in 2001. Other plants are increasing their efficiency by also using higher temperatures and pressures in the combustion of coal. With further increases in technology, it is expected that thermal efficiency will reach 55%.

As a vast majority of the world's coal-fired energy is produced using pulverised fuel, controlling emissions is important. Many technologies are employed by power stations to reduce emissions. Fly ash is removed using electrostatic precipitators or fabric filters. Oxides of sulphur are removed using flue gas desulphurisation processes, and are used in the manufacture of gypsum for building needs. Nitrogen oxides are also removed from emissions through either selective catalytic reduction or reburning.

Carbon dioxide produced during the combustion of fossil fuels can be captured at the point of emission and stored underground using a process called carbon sequestration. Separated carbon dioxide can be stored in geological formations including oil and gas reservoirs, unmineable coal seams, and saline formations, in permeable rock layers. The carbon dioxide is trapped by impermeable overlying layers, ensuring relatively safe storage underground. It can also be used in the creation of valuable by-products. Carbon sequestration is presently occurring in Australia and Norway.

An alternative to the use of pulverized fuel power stations is oxy-fuel combustion. The process involves feeding a modified power station boiler with pure oxygen rather than air, and recycling a proportion of flue gases. This increases carbon dioxide in flue gas, making it easier to capture and store. This process is potentially applicable to Australia, as it would require only a retrofit of Australia's existing coal-fired power stations. CS Energy is presently implementing this technology at its Callide power station.