I'm not a bot

This is the most important parameter that determines the economics of the power plant operation.It indicates the amount of heat that is released when the coal is burned. The Calorific Value varies on the geographical age, formation, ranking and location of the coal mines. It is expressed as kJ/kg in the SI unit system. Power plant coals have a Calorific Value in the range of 9500 kJ/kg to 27000 kJ/ kg.The calorific value is expressed in two different ways on account the moisture in the coal. Coal contains moisture. When coal burns the moisture in coal evaporates taking away some heat of combustion which is not available for our use.When we say Gross Calorific Value or Higher Heating Value it is the total heat released when burning the coal.When we say Nett Calorific Value or Lower Heating Value it is the heat energy available after reducing the loss due to moisture.The Heating Value determines how much fuel is required in the power plant. Higher the Calorific Value lesser the amount of the coal required per unit of Electricity. Higher Calorific value also means the cost of the coal is higher but is offset by the lower cost of logistics, storage and ash disposal.MoistureThe coal when mined contains moisture. The moisture is in two forms. First is the inherent moisture which is entrapped within the structure of the coal. Second is the external moisture that is outside of the coal structure. The amount of moisture depends again on the geographical age, location and condition in the mines. A part of this moisture can easily evaporate in atmospheric conditions during its transfer from the mines, storage at the power plant and finally feeding to the boiler in the power plant. Depending on where and when you determine the moisture, values will be different for the same of coal.The amount of moisture determines how much of heating is to be done to dry the coal before it is burned in the boiler.Reporting Coal PropertiesMoisture in coal is expressed as % by weight. So the change in the moisture content changes the proportion of the other coal constituents and the Calorific Value.'As Received' coal, is the coal received in the power plant premises. The payment to the coal companies are normally made based on the 'As Received' coal properties.'As Fired' coal is the coal entering the boiler system. The performance of the boiler and power plant is based on the 'As Fired' coal properties.'Air Dried' coal is what is used in the laboratory for analysis. This coal is dried in atmosphere and has the lowest amount of moisture. Laboratory results are reported as 'Air Dried' coal properties.The difference between the above three conditions is the proportion of the Moisture. The Calorific Value and other coal constituents analysed in the laboratory on 'Air Dried' basis is converted to 'As received' or 'As Fired' basis proportional to the moisture content. Enjoy sharper detail, more accurate color, lifelike lighting, believable backgrounds, and more with our new model update. Your generated images will be more polished than ever.See What's NewExplore how consumers want to see climate stories told today, and what that means for your visuals.Download Our Latest VisualGPS ReportData-backed trends. Generative AI demos. Answers to your usage rights questions. Our original video podcast covers it all—now on demand.Watch NowEnjoy sharper detail, more accurate color, lifelike lighting, believable backgrounds, and more with our new model update. Your generated images will be more polished than ever.See What's NewExplore how consumers want to see climate stories told today, and what that means for your visuals.Download Our Latest VisualGPS ReportData-backed trends. Generative AI demos. Answers to your usage rights questions. Our original video podcast covers it all—now on demand.Watch NowEnjoy sharper detail, more accurate color, lifelike lighting, believable backgrounds, and more with our new model update. Your generated images will be more polished than ever.See What's NewExplore how consumers want to see climate stories told today, and what that means for your visuals.Download Our Latest VisualGPS ReportData-backed trends. Generative AI demos. Answers to your usage rights questions. Our original video podcast covers it all—now on demand.Watch Now In this interactive diagram, students learn how a power station works. Students build the coal fired energy plant by dragging images into the correct position and in the correct order, then select captions to match. Educational value statement Shows the main components and processes in a coal-fired power station Includes explanations of the functions of each component Provides some basic feedback to students. Key learning objectives Students explain how energy from coal can be used to generate electricity Students recognise that energy appears in different forms including movement (kinetic energy), heat and potential energy, and causes change within systems. Strands Science Understanding: Physical sciences. In Coal Power Plant or Steam Power Plant, the water is converted into steam and the steam expanded in a turbine to produce kinetic energy which is converted into mechanical energy. The Coal Power Plant or Steam Power Plant has four major circuits by which the layout can be studied in detail. These are Coal and ash circuit Air and flue gas circuit Feed water and steam circuit Cooling water circuit 1. Coal and ash Circuit: This circuit consists of coal delivery, preparation of coal, handling of coal to the boiler furnace, ash handling and ash storage. The coal which is received from the mines are stored in coal storage. This raw coal is sized by crushers and then this prepared coal is transferred to the boilers. In the boiler, the coal is burnt and converted into ash. This ash is usually quenched to reduce the temperature, corrosion and dust content. Then it is stored at ash storage. 2. Air and Flue gas circuit: This circuit consists of forced draught fan, air-preheater, boiler furnace, super heater, economizer, dust collector, induced draught (ID) fan and chimney. The air from the atmosphere is forced into the circuit by a forced draught fan. This air is preheated in the air preheater by flue gases. This pre heated air is supplied to the furnace where this air is converted into flue gases. This flue gases pass over the boiler tubes by which the water is converted into steam. Then this flue gas is passed to the super heater where the steam is converted into super heated steam. Then it is passed to the economizer to heat the feed water and to the air preheater. The dust in the flue gases are collected by the dust collector and then left to atmosphere through chimney. 3. Feed water and steam flow circuit: This circuit consists of feed pump, economizer, boiler drum super heater, turbine and condenser. From the hot well, the feed water is pumped to the economizer where the water is preheated by the flue gases. This preheated water is supplied to the boiler drum. In the boiler drum, the pre heated water is converted into steam by burning of coal. The steam raised in boiler is passed through the super heater where the steam is converted into super heated steam. The super heated steam is expanded in turbine which is coupled with generator. The expanded steam is then passed through the condenser in which the steam is converted into water and this water is recirculated. 4. Cooling Water Circuit: This circuit consists of a pump, condenser and cooling tower. In the condenser, cold water is circulated to condense the steam in to water. The steam is condensed by loosing its latent heat to the circulating cold water. By this, the circulating water is heated. This hot water is cooled at the cooling tower, where the water is sprayed in the form of droplet through nozzles. The cold air enters the cooling tower from the bottom which cools the sprayed hot water. The cooled water is collected in the cooling pond and the same is re circulated again and again. To compensate the water lost due to vapourisation, the make up water is added to the pond by means of a pump.  More than half of the electricity generated in the world is by using coal as the primary fuel.The function of the coal fired thermal power plant is to convert the energy available in the coal to Electricity.Coal power plants work by using several steps to convert stored energy in coal to usable electricity that we find in our home that powers our lights, computers, and sometimes, back into heat for our homes.image provided by the Tennessee Valley AuthorityHow Coal Power Plants Produce ElectricityThe conversion from coal to electricity takes place in three stages.Stage 1The first conversion of energy takes place in the boiler. Coal is burnt in the boiler furnace to produce heat. Carbon in the coal and Oxygen in the air combine to produce Carbon Dioxide and heat.Stage 2The second stage is the thermodynamic process.The heat from combustion of the coal boils water in the boiler to produce steam. In modern power plant, boilers produce steam at a high pressure and temperature.The steam is then piped to a turbine.The high pressure steam impinges and expands across a number of sets of blades in the turbine.The impulse and the thrust created rotates the turbine.The steam is then condensed and pumped back into the boiler to repeat the cycle.Stage 3In the third stage, rotation of the turbine rotates the generator rotor to produce electricity based of Faraday's Principle of electromagnetic induction.Check out this series describing the layout of thermal power plants.Key Facts About Coal-Fired Electricity ProductionIn practice to effect these three stages of conversion, many systems and sub systems have to be in service. Also involved are different technologies, like combustion, aerodynamics, heat transfer, thermodynamics, pollution control, and logistics.As an example consider these facts for typical coal fired power plant of capacity 500 MW.Around 2 million tons of coal will be required each year to produce the continuous power.Coal combustion in the boiler requires air. Around 1.6 million cubic meter of air in an hour is delivered by air fans into the furnace.The ash produced from this combustion is around 200,000 tons per year.Electrostatic precipitators capture almost all of this ash without dispersing this to the atmosphere. Pollutants from coal power plants like carbon dioxide, sulphur dioxide, and nitrogen oxide can also affect the environment. Thermal power plants are the biggest producers of Carbon Dioxide.The boiler for typical 500 MW units produces around 1600 tons per hour of steam at a temperature of 540 to 600 degrees Centigrade. The steam pressures is in the range of 200 bar. The boiler materials are designed to withstand these conditions with special consideration for operational safety.Heat transfer from the hot combustion gases to the water in the boiler takes place due to Radiation and convection.The Electrical generators carry very large electric currents that produce heat and are be cooled by Hydrogen and water.The steam leaving the turbine is condensed and the water is pumped back for reuse in the boiler. To condense all the steam it will require around 50,000 cubic meter per hour of cooling water to be circulated from lakes, rivers or the sea. The water is returned to the source with only an increase of 3 to 4 degrees centigrade to prevent any effect to the environment.Apart from the cooling water the power plant also requires around 400 cubic meter per day of fresh water for making up the losses in the water steam cycle.Details of Generating Electricity from CoalThese are some of the facts to highlight the complexities of the working of a Coal Fired Power Plant generating Electricity.For more details, discover how coal is blended to the right mix to maximize energy production or learn about the specific caloric energies of coal and how moisture in the coal can affect a power plant's efficiency. Also learn how the coal is prepared to be fired in the boiler.You may also learn about the parts of a thermal power plant and site selection. In many nations, the blending of high grade imported coal with low grade high ash coals has long been adopted. Many methods may be used. The blending can occur at the coal mine, preparation plant, trans-shipment point, or at the power station. The method selected depends upon the site conditions, the level of blending required, the quantity to be stored and blended, the accuracy required, and the end use of the blended coal. Normally in large power stations handling very large quantities of coal, the stacking method with a fully mechanized system is followed.To decide to blend or not, it is very important to understand the composition of the coals that are to be blended. This means one will have to understand the origin of coal, the organic and inorganic chemistry of coal, and the behavior of the coals in questions. It has been established that coals produced by the drift theory of coal formation and coals formed by the swamp theory of coal formation have to be blended with caution. The main difference is that coal formed by drift theory exhibits pronounced regional variation in thickness and quality of seams. They also have enormously high ash content with varying inorganic chemistry. The organics of drift origin coal also present problems mainly because the vegetation that lead to the forming of the coal drifted from different places having different kind of vegetation. In contrast, the coals formed by the swamp theory have much more uniform organic properties and much lower ash content with consistent inorganic chemistry.During combustion, it is necessary to understand the physical conditions and coal properties during heating of the particles, devolatalisation, ignition and combustion of the volatile matter, and ignition and combustion of the char. It is also equally important to know the phase changes in mineral matter and other inorganics present in coal. The combustion efficiency and carbon loss will have to be also addressed during blending of coals. It is also necessary to look into the aspects of slagging, fouling, and emission characteristics like NOx, Sox, and particulates.Because of the complexity of the combustion process and the number of variables involved (which are still not fully understood), it is difficult to extrapolate small scale results to a full scale power plant. Thus, operational experience with a wide range of plant configurations with a variety of coal feedstock is essential for determining the practical significance of results from bench – and pilot – scale tests. More published research about how the behavior of the coals and coal blends utilized in tests differ from their actual performance in power station boilers is required.Predicting the risk of spontaneous combustion of coal stocks is another aspect of current fuel quality research. In addition to the inherent dangers, uncontrolled burning can lead to the release of pollutants. The economic issues associated with the loss of a valuable energy resource are also a concern.For more basic information, read about how coal power plants generate electricity by burning coal and find some other interesting facts about the process.The presence of trace elements in coal combustion has also received increased attention throughout the world during the last few years, with elements such as mercury of particular concern. One way to reduce trace element emissions is cleaning the coal prior to combustion. The use of cleaner coals – those with lower ash and sulfur content – can have the added advantage of substantially reducing operating costs. Again, however, some effects may be detrimental (ash deposition may be exacerbated, and the effects on corrosion and precipitator performance are uncertain), which makes testing vital.It has been found from field data that even if the blended coal closely resembles the design coal for the boiler, the blend need not perform the same way. This is mainly due to the transformation of inorganic particles during combustion and the way in which the organics are dispersed in coal. A limitation to blending coals is the compatibility of the coals themselves, and problems are more likely when blending petrographically different coals or coals with different ash chemistry. Non-additive properties make blend evaluation for power generation inherently complex. More work is required on understanding how the inorganic components of coals in the blend interact and how it affects ash behavior including its emissivity, reflectivity, and thermal conductivity.Blending decisions should be based on the knowledge of the specific behavior of a given pair of coals, rather than an assumption of linear variation of properties with blend traction. The ever more stringent constraints placed on coal-fired power stations worldwide and the continuing development of new technologies means that the issue of fuel quality improvement will remain a primary factor.About the AuthorDr V T Sathyanathan is a boiler consultant with 35 years of experience in various areas of high pressure boiler trouble shooting. He holds a PhD in coal combustion in boilers.Related ReadingCoal Formation Theories - Coal may be defined as a compact stratified mass of plant debris which has been modified chemically and physically by natural agencies, interspersed with smaller amounts of inorganic matter. In situ and Drift are the two major theories of coal formation.Coal Pulverising in Boilers - Pulverizing coal for a boiler is very important factor in overall cycle efficiency. There are many types of pulverizers available, but proper selection will ensure consistent boiler and cycle efficiency. This helps in carbon-dioxide reduction per million units of electricity generatedReading a Coal Flame in Tangential Firing Boilers - In a tangential coal fired boiler, the furnace act as a single burner and so it is required to look at and understand the quality of the flame. It is necessary to start from the control room of the boiler, then go to the mill, furnace, bottom ash and fly ash areas and study all in detail.Slagging and Deposition in Coal Fired Boiler - Deposition and slagging in coal fired boilers can be a major cause for poor performance and sometimes low availability of the unit. Here we look at some of the considerations involved. Coal-fired power plants are among the oldest forms of energy production in the world, and yet they remain essential sources of power around the globe. With new technological advances being made all the time, coal power plants are becoming increasingly efficient and clean. But it's also important to understand exactly how these plants work, so that's where coal power plant schematic diagrams come in.By understanding a coal power plant schematic diagram, we can gain insights into how these power plants function day to day. From the layout of the generator, turbines, and other equipment, to the flow of material and energy through the system, it provides us with an invaluable map of the inner workings of a coal-fired power plant. It can help us diagnose problems, improve performance, and generally get a better understanding of the underlying technology.These diagrams can be a bit complicated for the layperson, but with a bit of patience and some technical training, anyone can pick up a basic understanding of how a coal power plant schematic diagram works. On top of that, once you understand one diagram, it typically becomes much easier to familiarize yourself with others.So, whether you're an engineer looking to optimize the design of your plant, a homeowner trying to make sense of their local power grid, or just someone who has a basic interest in how power is produced, take a few moments to learn what exactly a coal power plant schematic diagram is and how it works. It's fascinating to understand the physics and engineering principles behind these diagrams and can open up a whole new world of knowledge. Coal fired power plants also known as coal fired power stations are facilities that burn coal to make steam in order to generate electricity. These stations, seen in Figure 1, provide ~40% of the world's electricity.[2] Countries such as South Africa use coal for 94% of their electricity and China and India use coal for 70-75% of their electricity needs, however the amount of coal China uses dwarfs most other countries (see the data visualization below).[3] The use of coal provides access to electricity to those who previously didn't have it, which helps to increase quality of life and reduce poverty in those regions, however it produces large quantities of different pollutants which reduces air quality and contributes to climate change. Burning huge amounts of coal Coal plants require enormous amounts of coal. Shockingly: a 1000 MWe coal plant uses 9000 tonnes of coal per day, equivalent to an entire train load (90 cars with 100 tonnes in each!).[4] The amount of coal used during a full year would then require 365 trains, and if each is 3 km long then a single train carrying all of this coal would need to be about 1100 km long; about the same distance as driving from Calgary AB to Victoria BC. If this train were to pass by your house at 40 kilometers per hour, it would take more than a day to pass! Figure 2. A coal train the length of 1100 kilometers, the distance from Calgary to Victoria, is needed per year for a 1000 MWe coal fired power plant.[5] The conversion of this coal to the end goal of electricity is a multi-faceted process:[6] The coal must be unloaded from the train. Traditional ways of doing this require the use of cranes picking up the coal from the cars, however newer plants have the floor underneath the train tracks drop away, allowing the coal to be dropped into underground containment. Doing so doesn't even require the train to stop moving![7] For a video of this please see here. Many coal plants are mine mouth which means the plant was put where the coal mine is, so the coal doesn't need to be transported by train. Once unloaded, the coal is then pulverized into a fine powder by a large grinder. This ensures nearly complete burning of the coal in order to maximize the heat given off and to minimize pollutants. The pulverized coal is then input to a boiler, where combustion occurs and the coal provides heat to the power plant. This heat is transferred to pipes containing high pressured water, which boils to steam. The steam then travels through a turbine, causing it to rotate extremely fast which in turn spins a generator, producing electricity. The electricity can then be input to the electrical grid for use by society. Coal fired power plants follow the Rankine cycle in order to complete this process. Since they require plenty of water to be circulated in this cycle, coal power plants need to be located near a body of water. The process of coal fired plants can be seen below in Figure 3. Figure 3. The process of a coal fired power plant to convert coal into electricity.[8] Environmental Impacts Coal power plants have many associated environmental impacts on the local ecosystem. Air pollution The burning of coal releases many pollutants - oxides of nitrogen (NOx) and sulfur (SOx) - and particulate matter. They also emit greenhouse gases, such as carbon dioxide ($CO_2$) and methane ($CH_4$), which are known to contribute to global warming and climate change. To help stunt the emission of these, power plants require technology to reduce the output of these harmful molecules.[9] Water Use/Pollution Large quantities of water are often needed to remove impurities from coal,[10] this process is known as coal washing. For instance, in China, around one-fifth of the water used in the coal industry is used for this process.[11] This process helps reduce air pollution, as it eliminates around 50% of the ash content in the coal. This results in less sulfur dioxide (SOx) being produced, along with less carbon dioxide ($CO_2$) due to higher thermal efficiencies.[12] When power plants remove water from the environment, fish and other aquatic life can be affected, along with animals relying on these sources.[10] Pollutants also build up in the water that power plants use, so if this water is discharged back into the environment it can potentially harm wildlife there.[10] The discharge of water from the power plants and coal washing requires monitoring and regulation. Visit the US Environmental Protection Agency (EPA) for more information on this. World Electricity Generation: Coal The map below shows which primary energy different countries get the energy to generate their electricity from. Coal is seen in grey. Click on the region to zoom into a group of countries, then click on the country to see where its electricity comes from. Some notable countries include China, India, USA, Russia, Canada, and France. For Further Reading References ↑ Wikimedia Commons [Online], Available: 27C%27_Power_Station_-_geograph.org.uk_-_35089.jpg ↑ H. Ritchie and M. Roser, "Fossil Fuels", Our World in Data, 2020. [Online]. Available: . [Accessed: 11- May- 2020]. ↑ Data Source: IEA (2014), "World energy balances", IEA World Energy Statistics and Balances (database). DOI: (Accessed February 2015) ↑ R. A. Hinrichs and M. Kleinbach, "Electricity: Circuits + Superconductors," in Energy: Its Use and the Environment, 4th ed. Toronto, Ont. Canada: Thomson Brooks/Cole, 2006, ch.10, sec.A, pp.320 ↑ Callum Black on Geograph. (June 23 2015). Coal train [Online], Available: ↑ R. A. Hinrichs and M. Kleinbach, "Electromagnetism and the Generation of Electricity," in Energy: Its Use and the Environment, 4th ed. Toronto, Ont. Canada: Thomson Brooks/Cole, 2006, ch.11, sec.D, pp.376-377 ↑ Discovery via user: Largest Dams, Coal Fired Power Plant - England [Online Video], Available: ↑ Wikimedia Commons [Online]. Available: ↑ BCC Research, "Air Pollution Control for Coal-Fired Power Plants", BCC Publishing, 2013. ↑ 10.0 10.1 10.2 EPA Clean Energy. (June 10 2015). Coal [Online]. Available: ↑ IEA. (June 22 2015). Why most coal avoids a bath [Online], Available: ↑ AP 42: Compilation of Air Pollutant Emissions Factors, Volume 1: Stationary Point and Area Sources, 5th ed. US Environmental Protection Agency, 2010, pp. 11.10-1. More than half of the electricity generated in the world is by using coal as the primary fuel.The function of the coal fired thermal power plant is to convert the energy available in the coal to Electricity.Coal power plants work by using several steps to convert stored energy in coal to usable electricity that we find in our home that powers our lights, computers, and sometimes, back into heat for our homes.image provided by the Tennessee Valley AuthorityHow Coal Power Plants Produce ElectricityThe conversion from coal to electricity takes place in three stages.Stage 1The first conversion of energy takes place in the boiler. Coal is burnt in the boiler furnace to produce heat. Carbon in the coal and Oxygen in the air combine to produce Carbon Dioxide and heat.Stage 2The second stage is the thermodynamic process.The heat from combustion of the coal boils water in the boiler to produce steam. In modern power plant, boilers produce steam at a high pressure and temperature.The steam is then piped to a turbine.The high pressure steam impinges and expands across a number of sets of blades in the turbine.The impulse and the thrust created rotates the turbine.The steam is then condensed and pumped back into the boiler to repeat the cycle.Stage 3In the third stage, rotation of the turbine rotates the generator rotor to produce electricity based of Faraday's Principle of electromagnetic induction.Check out this series describing the layout of thermal power plants.Key Facts About Coal-Fired Electricity ProductionIn practice to effect these three stages of conversion, many systems and sub systems have to be in service. Also involved are different technologies, like combustion, aerodynamics, heat transfer, thermodynamics, pollution control, and logistics.As an example consider these facts for typical coal fired power plant of capacity 500 MW.Around 2 million tons of coal will be required each year to produce the continuous power.Coal combustion in the boiler requires air. Around 1.6 million cubic meter of air in an hour is delivered by air fans into the furnace.The ash produced from this combustion is around 200,000 tons per year.Electrostatic precipitators capture almost all of this ash without dispersing this to the atmosphere. Pollutants from coal power plants like carbon dioxide, sulphur dioxide, and nitrogen oxide can also affect the environment. Thermal power plants are the biggest producers of Carbon Dioxide.The boiler for typical 500 MW units produces around 1600 tons per hour of steam at a temperature of 540 to 600 degrees Centigrade. The steam pressures is in the range of 200 bar. The boiler materials are designed to withstand these conditions with special consideration for operational safety.Heat transfer from the hot combustion gases to the water in the boiler takes place due to Radiation and convection.The Electrical generators carry very large electric currents that produce heat and are be cooled by Hydrogen and water.The steam leaving the turbine is condensed and the water is pumped back for reuse in the boiler. To condense all the steam it will require around 50,000 cubic meter per hour of cooling water to be circulated from lakes, rivers or the sea. The water is returned to the source with only an increase of 3 to 4 degrees centigrade to prevent any effect to the environment.Apart from the cooling water the power plant also requires around 400 cubic meter per day of fresh water for making up the losses in the water steam cycle.Details of Generating Electricity from CoalThese are some of the facts to highlight the complexities of the working of a Coal Fired Power Plant generating Electricity.For more details, discover how coal is blended to the right mix to maximize energy production or learn about the specific caloric energies of coal and how moisture in the coal can affect a power plant's efficiency. Also learn how the coal is prepared to be fired in the boiler.You may also learn about the parts of a thermal power plant and site selection. Coal fired power stations are used to generate electricity. They are the most common type of power station and the largest global megawatt (MW) contributor of all power station types. This type of power plant has found widespread application due to its tried and tested design, as well as the cheap availability of coal. Unfortunately, coal fired power plants -particularly older plants- are not environmentally friendly compared to other types of power generation plants. Coal fired power plants are non-renewable (not 'green') types of plant. How Coal Fired Thermal Power Stations Work The below video is an extract from our Mechanical and Electrical Engineering Explained Online Video Course. Coal is delivered to the plant via road, rail or ship, and deposited in a coal yard. Stacker reclaimers are used to gather coal and deposit it into hoppers, the hoppers then feed flatbed conveyors. Conveyors transport the coal from the coal yard to day silos within the main power station building. Each day silo contains enough coal for a set period of time when the power station is fully loaded e.g. one day silo may contain enough coal for one boiler at 12 hours of full load operation. The day silos ensure that any disruption to the supply chain from the coal yard to the day silos will not cause a disruption to the boiler and consequently power generation. Larger power stations may have several large watertube boilers, steam turbines and generators. It is standard practice for each power generation building to be referred to as a 'Block' e.g. Block A, Block B etc. Firetube boilers are used to provide the initial heating of the power plant steam systems. Day silos feed the boiler directly (old design and uncommon), or, by passing the coal through a coal pulverizer (standard design and common). Coal pulverizers increase the coal's contact surface area with the air by grinding the coal into small pieces. The pulverizer also dries the coal in order that combustion can more easily occur (reduced moisture content). The heat to dry the coal is recovered from the boiler exhaust gas stream. Pulverized coal from the pulverizer is blown into the boiler with the primary air stream. The coal at this stage is finely ground and very dry, both of these characteristics aid combustion. Combustion occurs and heat is generated (this plant is a 'thermal power plant'). The heat generated by the water tube boiler is used to change the state of water to steam. The steam is then discharged to a condenser steam turbine. The steam turbine is connected via a gearbox to an a.c. electrical generator. Alternating current then passes through switchgear prior to being distributed to an electrical transformer; the switchgear used will often be of the SF6 or vacuum design. The electrical transformer increases the output voltage and is referred to as a 'generator step-up (GSU)' transformer. The GSU increases the output voltage to match that of the electrical grid, this may be several hundred thousand volts e.g. 110kV, 220kV etc. Increasing the voltage reduces transmission losses and reduces the thickness of the transmission cables required (higher voltage means lower amps, lower amps means thinner conductors/cables can be used). Enjoying this article? Then be sure to check out our Engineering Video Courses! Each course has a quiz, handbook, and you will receive a certificate when you finish the course. Enjoy! Additional Resources , the free encyclopedia that anyone can edit. 109,638 active editors 7,014,808 articles in English HMS Neptune was a dreadnought battleship built for the Royal Navy in the first decade of the 20th century, the sole ship of her class. Laid down at HM Dockyard, Portsmouth, in January 1909, she was the first British battleship to be built with superfiring guns. Shortly after her completion in 1911, she carried out trials of an experimental fire-control director and then became the flagship of the Home Fleet. Neptune became a private ship in early 1914 and was assigned to the 1st Battle Squadron. The ship became part of the Grand Fleet when it was formed shortly after the beginning of the First World War in August 1914. Aside from participating in the Battle of Jutland in May 1916, and the inconclusive action of 19 August several months later, her service during the war generally consisted of routine patrols and training in the North Sea. Neptune was deemed obsolete after the war and was reduced to reserve before being sold for scrap in 1922 and subsequently broken up. (Full article...) Recently featured: Nominative determinism Donkey Kong Land History of education in Wales (1701–1870) Archive By email More featured articles About Wreckage of Thai Airways International Flight 114 ... that Thai prime minister Thaksin Shinawatra was minutes away from boarding an aircraft that exploded (wreckage pictured)? ... that L. Whitney Watkins was given the Bull Moose Party's nomination in a 1912 election despite his own opposition? ... that a 1915 film about Florence Nightingale was criticised for not mentioning her pet parrot? ... that the statue Receiver was repainted in 2013 to match the likeness of NFL player Donald Driver after his retirement? ... that actress Jennifer Metcalfe used the experience of her father's cancer in Episode 6465 of the British soap opera Hollyoaks? ... that economist Roger A. Freeman questioned the value of college and favored limiting access to it to a select few? ... that the children's novel Queenie portrays the early years of the NHS in England? ... that painter Nicolino Calyo left Naples after participating in a failed uprising against King Ferdinand IV, then fled Spain following the outbreak of the First Carlist War? ... that Class War was held responsible for the poll tax riots? Archive Start a new article Nominate an article Trifid and Lagoon nebulae The Vera C. Rubin Observatory in Chile releases the first light images (example shown) from its new 8.4-metre (28 ft) telescope. In basketball, the Oklahoma City Thunder defeat the Indiana Pacers to win the NBA Finals. An attack on a Greek Orthodox church in Damascus, Syria, kills at least 25 people. The United States conducts military strikes on three nuclear facilities in Iran. In rugby union, the Crusaders defeat the Chiefs to win the Super Rugby Pacific final. Ongoing: Gaza war Iran–Israel war Russian invasion of Ukraine timeline Sudanese civil war timeline Recent deaths: John R. Casani Richard Gerald Jordan Franco Testa Raymond Laflamme Gertrud Leutenegger Maria Voce Nominate an article June 28: Vidovdan in Serbia Ned Kelly 1880 – Police captured Australian bank robber and cultural icon Ned Kelly (pictured) after a gun battle in Glenrowan, Victoria. 1895 – The U.S. Court of Private Land Claims ruled that James Reavis's claim to 18,600 sq mi (48,000 km2) of land in present-day Arizona and New Mexico was "wholly fictitious and fraudulent". 1904 – In the worst maritime disaster involving a Danish merchant ship, SS Norge ran aground on Hasselwood Rock and sank in the North Atlantic, resulting in more than 635 deaths. 1950 – Korean War: South Korean forces began the Bodo League massacre, summarily executing tens of thousands of suspected North Korean sympathizers. 1969 – In response to a police raid at the Stonewall Inn in New York City, groups of gay and transgender people began demonstrations, a watershed event for the worldwide gay rights movement. Charles Cruft (b. 1852)Olga Sapphire (b. 1907)Meralda Warren (b. 1959)Aparna Rao (d. 2005) More anniversaries: June 27 June 28 June 29 Archive By email List of days of the year About Myosotis scorpioides, the water forget-me-not, is a herbaceous perennial flowering plant in the borage family, Boraginaceae. It is native to Europe and Asia, but is widely distributed elsewhere, including much of North America, as an introduced species and sometimes a noxious weed. It is an erect to ascending plant of up to 70 cm, bearing small (8–12 mm) flowers that become blue when fully open and have yellow centers. It is usually found in damp or wet habitats, such as bogs, ponds, streams, ditches, fen, and rivers. This focus-stacked photograph shows a water forget-me-not growing in Niitvälja bog, Estonia. Photograph credit: Ivar Leidus Recently featured: Whitehead's trogon Atacamite Turban Head eagle Archive More featured pictures Community portal – The central hub for editors, with resources, links, tasks, and announcements. Village pump – Forum for discussions about Wikipedia itself, including policies and technical issues. Site news – Sources of news about Wikipedia and the broader Wikimedia movement. Teahouse – Ask basic questions about using or editing Wikipedia. Help desk – Ask questions about using or editing Wikipedia. Reference desk – Ask research questions about encyclopedic topics. Content portals – A unique way to navigate the encyclopedia. Wikipedia is written by volunteer editors and hosted by the Wikimedia Foundation, a non-profit organization that also hosts a range of other volunteer projects: CommonsFree media repository MediaWikiWiki software development Meta-WikiWikimedia project coordination WikibooksFree textbooks and manuals WikidataFree knowledge base WikinewsFree-content news WikiquoteCollection of quotations WikisourceFree-content library WikispeciesDirectory of species WikiversityFree learning tools WikivoyageFree travel guide WiktionaryDictionary and thesaurus This Wikipedia is written in English. Many other Wikipedias are available; some of the largest are listed below. 1,000,000+ articles العربية Deutsch Español فارسی Français Italiano Nederlands 日本語 Polski Português Русский Svenska Українська Tiếng Việt 中文 250,000+ articles Bahasa Indonesia Bahasa Melayu Bân-lâm-gú Български Català Čeština Dansk Eesti Ελληνικά Esperanto Euskara עברית Հայերեն Magyar Norsk bokmål Română Simple English Slovenčina Srpski Srpskohrvatski Suomi Türkçe O'zbekcha 50,000+ articles Asturianu Azərbaycanca বাংলা Bosanski کوردی Frysk Gaeilge Galego Hrvatski ქართული Kurdî Latviešu Lietuvių Македонски Norsk nynorsk Shqip Slovenščina தமிழ் اردو Retrieved from " 2Battleship formation of the Royal Navy For the German counterpart during World War I, see I Battle Squadron. 1st Battle SquadronThe 1st Battle Squadron at sea, April 1915Active1912–1945Country United KingdomBranch Royal NavyTypeSquadronSize8 x BattleshipsPart ofGrand FleetMilitary unit The 1st Battle Squadron was a naval squadron of the British Royal Navy consisting of battleships. The 1st Battle Squadron was initially part of the Royal Navy's Grand Fleet. After World War I the Grand Fleet was reverted to its original name, the Atlantic Fleet. The squadron changed composition often as ships were damaged, retired or transferred. As an element in the Grand Fleet, the Squadron participated in the Battle of Jutland.[1] On 5 August 1914, the squadron was constituted as follows:[2] HMS Marlborough HMS Collingwood HMS Colossus HMS Hercules HMS Neptune HMS St. Vincent HMS Superb HMS Vanguard Revenge and Hercules en route to Jutland with the sixth division. During the Battle of Jutland, the composition of the 1st Battle Squadron was as follows:[1] Sixth Division HMS Marlborough Flagship of Vice-Admiral Sir Cecil Burney; Captain G. P. Ross; HMS Revenge Captain E. B. Kiddle; HMS Hercules Captain L. Clinton-Baker; HMS Agincourt Captain H. M. Doughty; Fifth Division HMS Colossus Flagship of Rear Admiral E. F. A. Gaunt; Captain A. D. P. R. Pound; HMS Collingwood Captain J. C. Ley; HMS St. Vincent Captain W. W. Fisher; HMS Neptune Captain V. H. G. Bernard; HMS Revenge Following the Battle of Jutland, the 1st Battle Squadron was reorganized, with Colossus, Hercules, St. Vincent, Collingwood and Neptune all transferred to the 4th Battle Squadron. In January 1917, the squadron was constituted as follows:[3] HMS Marlborough HMS Agincourt HMS Benbow – joined July, 1916 HMS Canada HMS Emperor of India – joined July, 1916 HMS Revenge HMS Royal Oak – joined May, 1916 HMS Royal Sovereign – joined June, 1916 By 1918, Agincourt had been transferred to the 2nd Battle Squadron, and Resolution, Ramillies and Iron Duke had joined the squadron on completion.[4] For many years the squadron served in the Mediterranean as the main British battle force there. On 3 September 1939 the 1st Battle Squadron, serving in the Mediterranean Fleet, consisted of Barham, Warspite and Malaya, with headquarters at Alexandria, Egypt, under the command of Vice-Admiral Geoffrey Layton.[5] In December 1943 the Squadron was under the command of Vice Admiral Arthur Power. In January 1944 the Eastern Fleet was reinforced by HMS Queen Elizabeth, HMS Renown, HMS Valiant, HMS Illustrious, HMS Unicorn and seven destroyers. The Admiralty sent this force out to India under the title of the First Battle Squadron.[6] From November 1944, the squadron served in the British Pacific Fleet under the command of Vice-Admiral Henry Rawlings, who also served as Second-in-Command of the Fleet. It consisted of HMS King George V, HMS Howe, HMS Duke of York and HMS Anson at various times. Commanders were as follows:[7] Vice-Admiral Sir Stanley Colville (1912–14) Vice-Admiral Sir Lewis Bayly (June–December 1914) Admiral Sir Cecil Burney (1914–16) Vice-Admiral Sir Charles Madden (1916–19) Vice-Admiral Sir Sydney Fremantle (1919–21) Vice-Admiral Sir William Nicholson (1921–22) Vice-Admiral Sir Edwyn Alexander-Sinclair (1922–24) Rear-Admiral William Fisher (1924–25) Rear-Admiral Cecil Staveley (1925–26) Vice-Admiral Sir Michael Hodges (1926–27) Vice-Admiral Sir John Kelly (1927–29) Vice-Admiral Howard Kelly (1929–30) Vice-Admiral Sir William Fisher (1930–32) Vice-Admiral Sir Roger Backhouse (1932–34) Vice-Admiral Sir Charles Forbes (1934–36) Vice-Admiral Hugh Binney (1936–38) Rear-Admiral Ralph Leatham (1938–39) Vice-Admiral Geoffrey Layton (January–November 1939) Rear-Admiral Henry Pridham-Wippell (July–October 1940) Vice-Admiral John Tovey (October–December 1940) Rear-Admiral Bernard Rawlings (1940–41) Vice-Admiral Sir Henry Pridham-Wippell (1941–42) Vice-Admiral Sir Arthur Power (1943–44) Vice-Admiral Sir Bernard Rawlings (1944–45) Post holders included:[8] Rear-Admiral Charles E. Madden, 5 January 1912 – 10 November 1912 Rear-Admiral The Hon. Somerset A. Gough-Calthorpe, 10 December 1912 – 10 December 1913 Rear-Admiral Hugh Evan-Thomas, 10 December 1913 – 25 August 1915 Rear-Admiral Ernest Gaunt, 25 August 1915 – 12 June 1916 Rear-Admiral Alexander L. Duff, 12 June 1916 – 30 November 1916 Rear-Admiral Sir William C. M. Nicholson, 1 December 1916 – 20 March 1919 Rear-Admiral The Hon. Victor A. Stanley, 1 April 1919 – 1 April 1920 Rear-Admiral Henry M. Doughty, 24 March 1920 – 14 April 1921 Rear-Admiral Sir Rudolf W. Bentinck, 3 May 1921 – 3 May 1922 Rear-Admiral Arthur A. M. Duff, 3 May 1922 Rear-Admiral William A. H. Kelly, 3 May 1923 Rear-Admiral William H. D. Boyle, 3 May 1924 – 3 May 1924 Rear-Admiral William W. Fisher, 14 October 1924 – 7 September 1925 Rear-Admiral Cecil M. Staveley, 15 October 1925 – 1 October 1926 Rear-Admiral David T. Norris, 1 October 1926 Rear-

particularly the Paris Agreement, has garnered attention.[70] The Paris Agreement aims to restrict global warming to well below 2 degrees Celsius and ideally limit it to 1.5 degrees Celsius. Achieving these goals necessitates a substantial reduction in coal-related activities.[71] Studies, including finance-based accounting of coal emissions, have revealed a misalignment of coal financing with climate objectives.[70] Major nations, such as China, Japan, and the U.S., have extended financial support to overseas coal power infrastructure.[69][72] The largest backers are Chinese banks under the Belt and Road Initiative (BRI).[73][69] This support has led to significant long-term climate and financial risks and harms the objectives of reducing CO2 emissions set by the Paris Agreement, of which China, the United States and Japan are signatories. A substantial portion of the associated CO2 emissions is anticipated to occur after 2019.[70] Coal financing poses challenges to the global decarbonization of the power generation sector.[72] As renewable energy technologies become cost-competitive, the economic viability of coal projects diminishes, making past fossil fuel investments less attractive.[74] To address these concerns and align with climate goals, there is a growing call for stricter policies regarding overseas coal financing.[69][70] Countries, including Japan and the U.S., have faced criticism for permitting the financing of certain coal projects. Strengthening the policies, potentially by banning public financing of coal projects entirely, would enhance their climate efforts and credibility. In addition, Enhanced transparency in disclosing financing details is crucial for evaluating their environmental impacts.[70] In India capacity factors are below 60%.[75] In 2020 coal-fired power stations in the United States had an overall capacity factor of 40%; that is, they operated at a little less than half of their cumulative nameplate capacity.[76] If global warming is limited to well below 2 °C as specified in the Paris Agreement, coal plant stranded assets of over US$500 billion are forecast by 2050, mostly in China.[77] In 2020 think tank Carbon Tracker estimated that 39% of coal-fired plants were already more expensive than new renewables and storage and that 73% would be by 2025.[78] As of 2020[update] about half of China's coal power companies are losing money and old and small power plants "have no hope of making profits".[79] As of 2021[update] India is keeping potential stranded assets operating by subsidizing them.[80][81][82] Greenpeace protesting against coal at the German Chancellery In May 2021, the G7 committed to end support for coal-fired power stations within the year.[83] The G7's commitment to end coal support is significant as their coal capacity decreased from 23% (443 GW) in 2015 to 15% (310 GW) in 2023, reflecting a shift towards greener policies. This contrasts with China and India, where coal remains central to energy policy.[29]:11 As of 2023, the Group of Twenty (G20) holds 92% of the world's operating coal capacity (1,968 GW) and 88% of pre-construction capacity (336 GW).[29]:11 The energy policy of China regarding coal and coal in China are the most important factors regarding the future of coal-fired power stations, because the country has so many.[84] According to one analysis local officials overinvested in coal-fired power in the mid-2010s because central government guaranteed operating hours and set a high wholesale electricity price.[85] In democracies coal power investment follows an environmental Kuznets curve.[86] The energy policy of India about coal is an issue in the politics of India.[87][88] In the 21st century people have often protested against opencast mining, for example at Hambach Forest, Akbelen Forest and Ffos-y-fran;[89][90] and at sites of proposed new plants, such as in Kenya[91] and China.[92] Powering Past Coal Alliance Global Energy Monitor ^ the number 7120 in the cite is actually the number of units - as explained by Global Energy Monitor plants may have more than one unit ^ "Coal burning capacity climbs worldwide despite pledges to reduce use". PBS News. 6 April 2023. Retrieved 16 November 2024. ^ a b c "What would it cost to kill coal?". The Economist. ISSN 0013-0613. Retrieved 16 November 2024. Cumulative emissions from coal since 1882 amount to 800bn tonnes, the single biggest factor driving the warming that makes today's world about 1.2°C warmer than that of 1882. Most of that coal has been burned to produce electricity. Today's plants are producing about 12bn tonnes a year. ^ a b c d Birol, Fatih; Malpass, David (8 October 2021). "It's critical to tackle coal emissions – Analysis". International Energy Agency. Retrieved 9 October 2021. ^ "How safe is nuclear energy?". The Economist. ISSN 0013-0613. Retrieved 26 December 2022. ^ a b Cropper, Maureen; Cui, Ryna; Guttikunda, Sarath; Hultman, Nate; Jawahar, Puja; Park, Yongjoon; Yao, Xinlu; Song, Xiao-Peng (2 February 2021). "The mortality impacts of current and planned coal-fired power plants in India". Proceedings of the National Academy of Sciences. 118 (5). Bibcode:2021PNAS..11817936C. doi:10.1073/pnas.2017936118. ISSN 0027-8424. PMC 7865184. PMID 33495332. ^ "Killed by coal: Air pollution deaths in Jakarta 'may double' by 2030". The Jakarta Post. Retrieved 8 April 2022. ^ Boom and Bust Coal 2024 (PDF) (Report). San Francisco, California: Global Energy Monitor. April 2024. p. 7, 21. Retrieved 11 April 2024. 2% annual increase in the global operating coal fleet, which currently stands at 2,130 GW [...] Figure 16: Global coal power capacity continues steady growth despite Paris Agreement, with a 2% uptick in 2023 ^ "It's critical to tackle coal emissions – Analysis". International Energy Agency. 8 October 2021. Retrieved 9 October 2021. Coal power plants produce a fifth of global greenhouse gas emissions – more than any other single source. ^ "Country Inventory". Climate TRACE. Retrieved 16 November 2024. ^ "China generated over half world's coal-fired power in 2020: study". Reuters. 28 March 2021. Retrieved 14 September 2021. China generated 53% of the world's total coal-fired power in 2020, nine percentage points more that five years earlier ^ Morton, Adam (3 August 2020). "More coal power generation closed than opened around the world this year, research finds". The Guardian. ISSN 0261-3077. Retrieved 4 August 2020. ^ a b c "The dirtiest fossil fuel is on the back foot". The Economist. 3 December 2020. ISSN 0013-0613. Retrieved 12 December 2020. ^ Piven, Ben. "EU power sector emissions drop as coal collapses across Europe". Al Jazeera. Retrieved 21 March 2020. ^ Roberts, David (14 March 2020). "4 astonishing signs of coal's declining economic viability". Vox. Retrieved 21 March 2020. ^ "China pledges to stop building new coal energy plants abroad". BBC News. 22 September 2021. Retrieved 22 September 2021. ^ Borenstein, Severin; Bushnell, James B. (1 November 2022). "Do Two Electricity Pricing Wrongs Make a Right? Cost Recovery, Externalities, and Efficiency" (PDF). American Economic Journal: Economic Policy. 14 (4): 80–110. doi:10.1257/pol.20190758. Retrieved 11 November 2022. ^ Davis, Lucas (21 September 2020). "Time to Vote Out Coal". Energy Institute Blog. Retrieved 27 September 2020. ^ Harrabin, Roger (12 March 2020). "Coal power developers 'risk wasting billions'". BBC News. ^ a b "The dirtiest fossil fuel is on the back foot". The Economist. 3 December 2020. ISSN 0013-0613. ^ Erickson, Camille (7 October 2019). "Mixing water, Powder River Basin coal ash dangerous to human health, new research finds". Casper Star-Tribune. Casper, WY. ^ Brooke, Nelson (5 June 2019). "New Interactive Maps of Groundwater Pollution Reveal Threats Posed by Alabama Power Coal Ash Pits". Black Warrior Riverkeeper. Birmingham, AL. ^ U.S. Environmental Protection Agency (EPA), Washington, D.C. (21 June 2010)."Hazardous and Solid Waste Management System; Identification and Listing of Special Wastes; Disposal of Coal Combustion Residuals From Electric Utilities; Proposed rule." Federal Register, 75 FR 35151 ^ Scott, Allan N.; Thomas, Michael D. A. (January–February 2007). "Evaluation of Fly Ash From Co-Combustion of Coal and Petroleum Coke for Use in Concrete". ACI Materials Journal. 104 (1). Farmington Hills, MI: American Concrete Institute: 62–70. doi:10.14359/18496. ^ "Status of Power System Transformation 2018: Summary for Policy Makers". IEA Webstore. Archived from the original on 10 May 2020. Retrieved 3 July 2019. ^ "Flexibility Toolbox". vgb.org. Retrieved 3 July 2019. ^ "Battery Power's Latest Plunge in Costs Threatens Coal, Gas". BloombergNEF. 26 March 2019. Retrieved 3 July 2019. ^ a b c d "Global Electricity Review 2021 - Global Trends". Ember. 28 March 2021. Archived from the original on 28 March 2021. Retrieved 7 July 2021. ^ "Boom and Bust 2021: TRACKING THE GLOBAL COAL PLANT PIPELINE" (PDF). Global Energy Monitor. Archived (PDF) from the original on 6 April 2021. ^ a b c Monitor, Global Energy; CREA; E3G; Finance, Reclaim; Club, Sierra; SFOC; Network, Kiko; Europe, C. a. N.; Groups, Bangladesh; Asia, Trend; ACJCE; Sustentable, Chile; POLEN; ICM; Arayara (10 April 2024). "Boom and Bust Coal 2024". Global Energy Monitor: 11.{{cite journal}}: CS1 maint: numeric names: authors list (link) ^ Do, Thang Nam; Burke, Paul J. (1 June 2024). "Phasing out coal power in two major Southeast Asian thermal coal economies: Indonesia and Vietnam". Energy for Sustainable Development. 80: 101451. Bibcode:2024ESusD..8001451D. doi:10.1016/j.esd.2024.101451. hdl:1885/317223. ISSN 0973-0826. ^ "Coal". iea.org. Retrieved 5 July 2019. ^ Patel, Sonal (3 August 2020). "Xuzhou 3 Shows the Future of Subcritical Coal Power Is Sublime". POWER Magazine. Retrieved 4 August 2020. ^ "Emissions". iea.org. Archived from the original on 12 August 2019. Retrieved 4 July 2019. ^ "BP Statistical Review of World Energy 2019" (PDF). ^ Environment, U. N. (19 November 2019). "Emissions Gap Report 2019". UNEP - UN Environment Programme. Retrieved 22 January 2020. ^ a b "Retired Coal-fired Power Capacity by Country / Global Coal Plant Tracker". Global Energy Monitor. 2023. Archived from the original on 9 April 2023. — Global Energy Monitor's Summary of Tables (archive) ^ Shared attribution: Global Energy Monitor, CREA, E3G, Reclaim Finance, Sierra Club, SFOC, Kiko Network, CAN Europe, Bangladesh Groups, ACJCE, Chile Sustentable (5 April 2023). "Boom and Bust Coal / Tracking the Global Coal Plant Pipeline" (PDF). Global Energy Monitor. p. 3. Archived (PDF) from the original on 7 April 2023.{{cite web}}: CS1 maint: multiple names: authors list (link) CS1 maint: numeric names: authors list (link) ^ "New Coal-fired Power Capacity by Country / Global Coal Plant Tracker". Global Energy Monitor. 2023. Archived from the original on 19 March 2023. — Global Energy Monitor's Summary of Tables (archive) ^ Overland, Indra; Loginova, Julia (1 August 2023). "The Russian coal industry in an uncertain world: Finally pivoting to Asia?". Energy Research & Social Science. 102: 103150. Bibcode:2023ERSS..10203150O. doi:10.1016/j.erss.2023.103150. ISSN 2214-6296. ^ Wang, Pu; Lin, Cheng-Kuan; Wang, Yi; Liu, Dachuan; Song, Dunjiang; Wu, Tong (29 November 2021). "Location-specific co-benefits of carbon emissions reduction from coal-fired power plants in China". Nature Communications. 12 (1): 6948. Bibcode:2021NatCo..12.6948W. doi:10.1038/s41467-021-27252-1. ISSN 2041-1723. PMC 8629986. PMID 34845194. ^ Do, Thang; Burke, Paul J (2023). "Phasing out coal power in a developing country context: Insights from Vietnam". Energy Policy. 176 (May 2023 113512): 113512. Bibcode:2023EnPol.17613512D. doi:10.1016/j.enpol.2023.113512. hdl:1885/286612. S2CID 257356936. ^ NAGATANI Genichiro; ISHII Hiroki; ITO Takamasa; OHNO Emi; OKUMA Yoshitomo (January 2021). "Development of Co-Firing Method of Pulverized Coal and Ammonia to Reduce Greenhouse Gas Emissions" (PDF). IHI Corporation. Archived from the original (PDF) on 21 October 2021. Retrieved 8 November 2021. ^ Darrell Proctor (24 May 2020). "Project Will Burn Ammonia with Coal to Cut Emissions". Power Magazine. Retrieved 8 November 2021. ^ "JERA and IHI to Start a Demonstration Project Related to Ammonia Co-firing at a Large-Scale Commercial Coal-Fired Power Plant". JERA. 24 May 2020. Retrieved 13 November 2021. ^ "Japan Inc. ups its game in offshore wind power". IHS Markit. 28 September 2021. Retrieved 7 December 2021. ^ "Uskmouth Power Station Conversion Project Update and EPP Contract Award". SIMEC Atlantis Energy. 5 November 2018. Archived from the original on 7 May 2020. Retrieved 4 July 2019. ^ "Thermal blocks could convert coal-fired power stations to run fossil-fuel free". Australian Broadcasting Corporation. 7 September 2020. ^ China's New Growth Pathway: From the 14th Five-Year Plan to Carbon Neutrality (PDF) (Report). Energy Foundation China. December 2020. Archived from the original (PDF) on 16 April 2021. ^ "Post-Combustion Capture Retrofit: Evolving Current Infrastructure for Cleaner Energy | UKCCS Research Centre". ukccsrc.ac.uk. Archived from the original on 4 July 2019. Retrieved 4 July 2019. ^ The Guardian, 23 Nov. 2023 US Coal Power Plants Killed at Least 460,000 People in Past 20 Years--Report ^ Commission Implementing Decision (EU) 2017/1442 of 31 July 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for large combustion plants (notified under document C(2017) 5225) (Text with EEA relevance. ), 17 August 2017, retrieved 5 July 2019 ^ "Mercury and Air Toxics Standards". Washington, D.C.: United States Environmental Protection Agency (EPA). 19 June 2019. ^ a b "Steam Electric Power Generating Effluent Guidelines—2015 Final Rule". EPA. 6 November 2019. ^ "Special Wastes". Hazardous Waste. EPA. 29 November 2018. ^ "Chronic coal pollution". Bankwatch. Prague: CEE Bankwatch Network. Retrieved 5 July 2019. ^ a b Schipper, Ori (18 February 2019). "The global impact of coal power". ETH Zurich. ^ "Death rates from energy production per TWh". Our World in Data. Retrieved 26 November 2021. ^ Vohra, Karn; Vodonos, Alina; Schwartz, Joel; Marais, Eloise A.; Sulprizio, Melissa P.; Mickley, Loretta J. (1 April 2021). "Global mortality from outdoor fine particle pollution generated by fossil fuel combustion: Results from GEOS-Chem". Environmental Research. 195: 110754. Bibcode:2021ER....19510754V. doi:10.1016/j.envres.2021.110754. ISSN 0013-9351. PMID 33577774. S2CID 231909881. ^ Hausfather, Zeke (18 November 2016). "Coal in China: Estimating Deaths per GW-year". Berkeley Earth. Berkeley, CA. Retrieved 1 February 2020. ^ Henneman, Lucas; Choirat, Christine; Dedoussi, Irene; Dominici, Francesca; Roberts, Jessica; Zigler, Corwin (24 November 2023). "Mortality risk from United States coal electricity generation". Science. 382 (6673): 941–946. Bibcode:2023Sci...382..941H. doi:10.1126/science.adf4915. ISSN 0036-8075. PMC 10870829. PMID 37995235. ^ Milman, Oliver (4 March 2019). "Most US coal plants are contaminating groundwater with toxins, analysis finds". The Guardian. ISSN 0261-3077. ^ "Mercury Experiment to Assess Atmospheric Loading in Canada and the United States (METAALICUS)". IISD Experimental Lakes Area. 15 May 2015. Retrieved 7 July 2020. ^ "Researching Atmospheric Mercury and Freshwater Fish". IISD Experimental Lakes Area. 2 April 2016. Retrieved 7 July 2020. ^ "When a lake is better than a lab". Canadian Geographic. 8 August 2018. Retrieved 7 July 2020. ^ a b "Acid Rain". IISD Experimental Lakes Area. 4 April 2016. Retrieved 7 July 2020. ^ "IISD Experimental Lakes Area: The world's living freshwater laboratory". BioLab Business Magazine. 12 February 2020. Retrieved 7 July 2020. ^ Tong, Dan; Zhang, Qiang; Liu, Fei; Geng, Guannan; Zheng, Yixuan; Xue, Tao; Hong, Chaopeng; Wu, Ruili; Qin, Yu (6 November 2018). "Current Emissions and Future Mitigation Pathways of Coal-Fired Power Plants in China from 2010 to 2030". Environmental Science & Technology. 52 (21): 12905–12914. Bibcode:2018EnST...5212905T. doi:10.1021/acs.est.8b02919. ISSN 0013-936X. PMID 30249091. S2CID 206581545. ^ EIA. "More than 100 coal-fired plants have been replaced or converted to natural gas since 2011". Energy Information Administration. US Department of Energy. Retrieved 26 May 2021. ^ a b c d Manych, Niccolò; Steckel, Jan Christoph; Jakob, Michael (2021). "Finance-based accounting of coal emissions". Environmental Research Letters. 16 (4): 044028. Bibcode:2021ERL....16d4028M. doi:10.1088/1748-9326/abd972. S2CID 233704266. ^ a b c d e Chen, Xu; Li, Zhongshu; Gallagher, Kevin P.; Mauzerall, Denise L. (15 October 2021). "Financing carbon lock-in in developing countries: Bilateral financing for power generation technologies from China, Japan, and the United States". Applied Energy. 300: 117318. Bibcode:2021ApEn..30017318C. doi:10.1016/j.apenergy.2021.117318. ISSN 0306-2619. ^ "UN Chief: Phase Out of Coal Is Key Climate Priority". unfccc.int. 18 January 2022. Retrieved 3 November 2023. ^ a b Trencher, Gregory; Healy, Noel; Hasegawa, Koichi; Asuka, Jusen (1 September 2019). "Discursive resistance to phasing out coal-fired electricity: Narratives in Japan's coal regime". Energy Policy. 132: 782–796. Bibcode:2019EnPol.132..782T. doi:10.1016/j.enpol.2019.06.020. ISSN 0301-4215. S2CID 198655858. ^ Crooks, Ed (30 June 2019). "The week in energy: China's coal-fired outreach". Financial Times. Retrieved 6 July 2019. ^ Creutzig, Felix; Agoston, Peter; Goldschmidt, Jan Christoph; Luderer, Gunnar; Nemet, Gregory; Pietzcker, Robert C. (25 August 2017). "The underestimated potential of solar energy to mitigate climate change". Nature Energy. 2 (9): 17140. Bibcode:2017NatEn...217140C. doi:10.1038/nenergy.2017.140. ISSN 2058-7546. S2CID 133826185. ^ "Boom and Bust 2021" (PDF). Archived (PDF) from the original on 6 April 2021. ^ Electric Power Monthly (Report). US Department of Energy. September 2021. ^ Saygin, Deger; Rigter, Jasper; Caldecott, Ben; Wagner, Nicholas; Gielen, Dolf (31 May 2019). "Power sector asset stranding effects of climate policies". Energy Sources, Part B: Economics, Planning, and Policy. 14 (4): 99–124. Bibcode:2019EneSB..14...99S. doi:10.1080/15567249.2019.1618421. S2CID 191757913. ^ How to Retire Early: Making accelerated coal phaseout feasible and just (Report). Carbon Tracker. June 2020. ^ "The Path Ahead for China's Coal Power Industry". hellenicshippingnews.com. Retrieved 23 January 2020. ^ "There's no way out for India's stranded thermal power assets". Institute for Energy Economics & Financial Analysis. 29 March 2021. Retrieved 7 December 2021. ^ "Mapping India's Energy Subsidies 2021: Time for renewed support to clean energy". International Institute for Sustainable Development. Retrieved 7 December 2021. ^ "Power freebies show pitfalls of electoral politics". The Times of India. Retrieved 7 December 2021. ^ "G7 commits to end support for coal-fired power stations this year". euronews. 21 May 2021. Retrieved 23 July 2021. ^ David Culver, Lily Lee and Ben Westcott (29 September 2019). "China struggling to kick its coal habit despite Beijing's big climate pledges". CNN. Retrieved 20 October 2019. ^ Ren, Mengjia; Branstetter, Lee; Kovak, Brian; Armanios, Daniel; Yuan, Jiahai (16 March 2019). "China overinvested in coal power: Here's why". VoxEU.org. Retrieved 6 July 2019. ^ Urpelainen, Johannes; Zucker, Noah; Clark, Richard (11 April 2019). "Political Institutions and Pollution: Evidence from Coal-Fired Power Generation". Review of Policy Research. Rochester, NY. SSRN 3370276. ^ "Indigenous residents protest huge coal mine plan in India". Eco-Business. 9 October 2020. Retrieved 11 October 2020. ^ "Unleashing coal: inside India's plans to open up commercial coal mining". mining-technology.com. September 2020. Retrieved 11 October 2020. ^ Ch, Aruna; rasekar (26 September 2017). "Successful Protests Against India's Coal Industry". Climate Tracker. Archived from the original on 15 May 2020. Retrieved 6 July 2019. ^ Matthew Robinson (23 June 2019). "Hundreds of climate protesters stage blockade in German coal mine". CNN. Retrieved 6 July 2019. ^ Leithead, Alastair (5 June 2019). "Row over Kenya World Heritage site coal plant". Retrieved 6 July 2019. ^ "Chinese protesters clash with police over power plant". The Guardian. 22 October 2012. ISSN 0261-3077. Retrieved 10 September 2023. Coal fired power plant Energy Education by the University of Calgary How a coal plant works video by the Tennessee Valley Authority How a coal plant works video by Ontario Power Generation Electricity from coal by the World Coal Association World's coal power plants mapped by Carbon Brief End Coal[usurped] by various environmental, social justice and health advocates Coal-fired power by the International Energy Agency Economics of coal by Carbon Tracker Centre for Research on Energy and Clean Air Retrieved from " Find out how a coal-fired power station makes electricity. This is an animated video in eleven parts which shows the components and processes in a coal-fired power station. The accompanying narration explains what happens in each stage. Most of the statistical information and examples relate to Queensland. QRC acknowledges the assistance provided by CS Energy and CSIRO Exploration and Mining in the production of this resource. Educational value statement Shows all stages of the power generation process, including fuel combustion, steam production, turbines and generators, transformers, the power grid, steam condensation, filtering of exhaust gases and mentions the potential for carbon capture and storage. Animations demonstrate how each process operates. Key learning objectives Students describe and explain the sequence of processes in coal-fired power stations Students describe the reversible and irreversible changes occurring in power stations Students describe and explain the energy transformations occurring in power stations. Strands Science Understanding: Chemical sciences; Physical sciences. Coal-Fired Power Plant: Coal-based power plants are a type of power plant that uses coal combustion to generate electricity. Countries like South Africa use coal for 94% of their electricity, and China and India use 70-75% of coal for their electricity needs; however, the amount of coal in China dwarfs that in other countries. Their use provides about 40% of the world's electricity, and they are mainly used in developing countries. The use of coal provides electricity to those who did not have it before, which helps to increase the quality of life & reduce poverty in those areas; however, it produces a large number of various pollutants that are used in the air. Reduces quality and contributes to climate change. Also, Read: What Is a Hydro Power Plant? | Working of Hydropower Plant | Types of Hydropower Plants Working of Coal Power Plant: The work of the coal power plant begins with the arrival of coal from the coal mines via trains. This coal is then transported to the power plant to be converted into a powder form. The main reason behind converting it into powders is to increase the efficiency of burning by increasing its contact area exposed to fire in the burner as compared to solid coal. This coal dust is fed through a blower in the boiler; The thermal energy released from this fuel is used to boil water up to 1000 degrees Fahrenheit, thus converting it into high-pressure steam that is transferred to turbines. This energy is used to generate electricity through a generator. Due to such high RPM, the voltage output of the generator is approximately 24000 volts, which can be transferred to about 40,000 volts via transmission cables. The steam is expanded one by one in 3 consecutive turbines to take full advantage of the pressure energy. These turbines actually turn at high RPMs, which convert pressure energy into mechanical energy. The temperature of thises water is kept under a safe range so that it does not harm the aquatic lives of the water body. Furthermore, to extract heat from this steam, the cold water of the reservoir or river is pumped into the condenser, and after heat exchange, it is pumped back into the water body. Also, Read: What Is a Solar Panel? | How Do Solar Panels Work? | Main Components of the Solar Panel | Working Principle of Solar Panels Main Components of Coal Power Plant: #1. Conveyor Belt Coals from the coal storage area are transported to the plant through a large conveyor belt. The load-carrying capacity of this belt is very high because very large quantities of coal are required every day. #2. Pulverizing Plant The coal transported by conveyor cannot be used in the same way as previously converted to powder, also known as inflated coal. It is designed to rotate in a cylindrical tank at high speed with several spherical steel balls and is thus converted into powder. The pulverizing plant also has un-pulse-enhanced coal storage and can store up to 30 hours of coal reserves. #3. Boiler The inflated coal is fed into the boiler through large fans flowing hot air. The boiler consists of several water-filled taps, and these tubes boil water up to 1000 degrees Fahrenheit and the flames in the boiler go up to 50 meters. #4. Turbine High-pressure steam at a thousand degrees Fahrenheit from the boiler and 3500 pounds per square inch of pressure is then fed to the steam turbine, which converts its pressurized energy into mechanical energy. #5. Generator A generator uses the mechanical energy generated by the turbines to generate electricity at significantly higher voltages. #6. Condenser The steam leaving the turbines is condensed into a condenser, which is pumped back into the boiler. Coldwater from a water source (river) or expansion process is used to cool steam into water. Also, Read: Top 10 Mechanical Companies in USA 2021 Pollution Control of Coal Power Plant: The biggest drawback of a coal power plant is its fly ash content and the release of sulfur dioxide during coal burning. All coal-fired power plants are always under the scrutiny of agencies involved in environmental pollution. Also, there is always pressure on developing countries to keep their pollution levels under control. Smoke-blowing ash is removed by a mechanical process, while sulfur dioxide is removed by reactions with lime, thus converting it into gypsums, which can be used in agricultural fields & many. There are other applications. The entire process takes place in a scrubber that is located between the boiler and the chimney. A mixture of lime and water is sprayed on the smoke emanating from the boiler, reducing the amount of ash blowing in the air by one percent and reducing the amount of sulfur dioxide by 93%. Preplated fly ash can also be used in making concrete & other anti-skid road materials. In some coal power plants, nitrogen dioxides are also removed from the smoke. It is passed into cars through a catalytic converter to remove nitrogen dioxide. The catalytic converter consists of layers of ammonia. When nitrogen dioxide is passed through these layers, it reacts with ammonia and is converted to nitrogen and water. Nitrogen is released into the atmosphere because the amount of nitrogen in the air we breathe is 71%, so it is quite safe. Also, Read: Top 10 Mechanical Companies in India 2021 Advantages of Coal Power Plant: It is one of the most reliable sources of energy, considering other power plants that depend on weather conditions, such as wind power plants and hydropower plants. It is the cheapest source of energy available to produce electricity for the good economic development of the country. Its end products, such as gypsum and precipitated ash, can be used in many applications. It is available in plenty, so there will be no interruptions in production in the coming years. Keeping India in mind, this energy generation tool employs a large part of the population. Also, Read: What Is Cooling Towers? | Working of Cooling Towers | Types of Cooling Towers Disadvantages of Coal Power Plant: It pollutes the environment by releasing harmful gas such as sulfur dioxide and nitrogen dioxide. Coal mines leave people with their own homes, as it is not safe to live in an area with mines. These gases have a harmful greenhouse effect, which is the most dangerous thing given the current environmental conditions. The carbon material released from the chimney in the form of fly ash pollutes the environment in the most adverse way. Application of Coal Power Plant: The coal power plant produces a large amount of electricity for our homes, hospital, industries, schools, etc. Coal has been used as a fuel source for locomotives for years. Also, Read: Keyless Remote Battery Is Low | When Does Key Fob Battery Replacing Replacing? | How to Replace a Keyless Remote Battery Frequently Asked Questions (FAQ) Coal-Fired Power Plant A coal-fired power plant, also known as a coal-fired power plant, is a plant that burns heat to make steam to produce electricity. These plants, shown in Figure 1, provide approximately 40% of the world's electricity. Coal Power Plant A coal-fired power station or coal power plant is a thermal power station that burns coal to generate electricity. Worldwide there are about 8,500 coal-fired power stations totaling over 2,000 gigawatts of capacity. How Does a Coal Power Plant Work? Coal-fired plants produce electricity by burning coal in a boiler to produce steam. The steam produced, under tremendous pressure, flows into a turbine, which spins a generator to create electricity. The steam is then cooled, condensed back into the water, and returned to the boiler to start the process over. Advantages of Coal Power Plant Huge Global Reserves. Not an Intermittent Energy Source. Reliable Fuel. Inexpensive Energy Source. Independent of the Weather. Plenty of Applications. Compatible With Other Energy Sources. Creates Jobs. Disadvantages of Coal Power Plant Air pollution from coal-fired power plants is linked with asthma, cancer, heart and lung ailments, neurological problems, acid rain, global warming, and other severe environmental and public health impacts. More than half of the electricity generated in the world is by using coal as the primary fuel.The function of the coal fired thermal power plant is to convert the energy available in the coal to Electricity.Coal power plants work by using several steps to convert stored energy in coal to usable electricity that we find in our home that powers our lights, computers, and sometimes, back into heat for our homes.image provided by the Tennessee Valley AuthorityHow Coal Power Plants Produce ElectricityThe conversion from coal to electricity takes place in three stages.Stage 1The first conversion of energy takes place in the boiler. Coal is burnt in the boiler furnace to produce heat. Carbon in the coal and Oxygen in the air combine to produce Carbon Dioxide and heat.Stage 2The second stage is the thermodynamic process.The heat from combustion of the coal boils water in the boiler to produce steam. In modern power plant, boilers produce steam at a high pressure and temperature.The steam is then piped to a turbine.The high pressure steam impinges and expands across a number of sets of blades in the turbine.The impulse and the thrust created rotates the turbine.The steam is then condensed and pumped back into the boiler to repeat the cycle.Stage 3In the third stage, rotation of the turbine rotates the generator rotor to produce electricity based of Faraday's Principle of electromagnetic induction.Check out this series describing the layout of thermal power plants.Key Facts About Coal-Fired Electricity ProductionIn practice to effect these three stages of conversion, many systems and sub systems have to be in service. Also involved are different technologies, like combustion, aerodynamics, heat transfer, thermodynamics, pollution control, and logistics.As an example consider these facts for typical coal fired power plant of capacity 500 MW.Around 2 million tons of coal will be required each year to produce the continuous power.Coal combustion in the boiler requires air. Around 1.6 million cubic meter of air in an hour is delivered by air fans into the furnace.The ash produced from this combustion is around 200,000 tons per year.Electrostatic precipitators capture almost all of this ash without dispersing this to the atmosphere. Pollutants from coal power plants like carbon dioxide, sulphur dioxide, and nitrogen oxide can also affect the environment. Thermal power plants are the biggest producers of Carbon Dioxide.The boiler for typical 500 MW units produces around 1600 tons per hour of steam at a temperature of 540 to 600 degrees Centigrade. The steam pressures is in the range of 200 bar. The boiler materials are designed to withstand these conditions with special consideration for operational safety.Heat transfer from the hot combustion gases to the water in the boiler takes place due to Radiation and convection.The Electrical generators carry very large electric currents that produce heat and are be cooled by Hydrogen and water.The steam leaving the turbine is condensed and the water is pumped back for reuse in the boiler. To condense all the steam it will require around 50,000 cubic meter per hour of cooling water to be circulated from lakes, rivers or the sea. The water is returned to the source with only an increase of 3 to 4 degrees centigrade to prevent any effect to the environment.Apart from the cooling water the power plant also requires around 400 cubic meter per day of fresh water for making up the losses in the water steam cycle.Details of Generating Electricity from CoalThese are some of the facts to highlight the complexities of the working of a Coal Fired Power Plant generating Electricity.For more details, discover how coal is blended to the right mix to maximize energy production or learn about the specific caloric energies of coal and how moisture in the coal can affect a power plant's efficiency. Also learn how the coal is prepared to be fired in the boiler.You may also learn about the parts of a thermal power plant and site selection.