

Illustration showing proposed layout of Kingsnorth site featuring Units 5 and 6 and demonstration-sized Carbon Capture and Storage (CCS) equipment and infrastructure. The CCS equipment shown removes flue gas from half of one of the proposed supercritical units and could be scaled up to incorporate a larger part of the plant.



The proposed new units

1. Boiler house

Coal is ground to a fine powder in pulverising mills and then mixed with warm air before being burned in the boilers. Each boiler is made up of miles of tubing in which pure feedwater is turned into steam. Supercritical technology allows this steam to be boosted to more than 600 degrees celsius and 290 bar pressure.

2. Turbine hall

Steam generated from the boiler expands through the turbines striking a series of blades around the turbine shafts. The energy transferred from the steam rotates the turbine shafts at 3000 revolutions per minute. Steam is returned to the boiler for reheating between the high and intermediate pressure turbines to maximise the amount of energy transferred.

As the turbine shaft rotates, it turns a huge magnet housed within the copper coils of the generator. As the magnet rotates, an electrical field is generated within the copper coils, producing electricity. The steam, having lost most of its energy driving the turbines, enters the condenser where it passes over small tubes containing cooling water drawn from the river Medway. The cooling water condenses the steam back to water so that it may begin its journey back around the boiler. The clean cooling water is then pumped back into the river Medway.

3. Transformer

Power is generated at 22,000 volts and is then boosted by the transformer to 400,000 Volts for onward transmission via the National Grid Transmission system.

4. Selective catalytic reduction (SCR)

The exhaust gases enter the SCR system. Ammonia is injected into the exhaust gases and the mixture reacted over a catalyst similar to a car's catalytic converter. This process reduces the concentration of oxides of nitrogen (NO_x) by more than 70%.

5. Electrostatic precipitators

Exhaust gases then enter the precipitators which will remove approximately 99.8% of the dust. An electrical field transfers to the dust particles in the gases which are then collected on an oppositely charged plate. Collected dust is stored temporarily on site in covered silos before being transported by road for use in the construction industry.

6. Flue gas desulphurisation (FGD)

The exhaust gas passes to the FGD plant where more than 90% of the sulphur dioxide emissions are removed. As the exhaust gases pass through a fine spray of limestone slurry, the sulphur dioxide contained in the gas reacts to produce calcium sulphate (gypsum) which is then used in applications such as plasterboard manufacture. Exhaust gas then passes to the chimney.

7. Direct contact cooler and absorber column

Flue gas from the FGD is cooled which helps drive the exothermic reaction that takes place in the absorber column. It then enters the bottom of the absorber column where it meets a counter-flowing amine solvent. The carbon dioxide (CO₂) in the flue gas reacts with

the amine reagent, binding to it to form a 'rich solvent'. The remaining 'cleaned' flue gas then rises to the top of the absorber column and then passes on to the chimney. This process removes approximately 90% of the CO₂ from the flue gas.

8. Stripper column

'Rich solvent' is heated by a supply of steam taken from the main power plant, reducing the output and efficiency of the power plant. Heating the solvent releases CO₂ which then rises to the top of the column where it is cooled and dried to produce a high purity CO₂ stream. Once it has cooled the amine solvent travels back to the absorber column where it is reused.

9. CO₂ compression

CO₂ released by the stripping process is compressed to make it flow along the pipeline. The amount of compression used depends on pipeline length and the pressure within the destination storage site and will increase as the storage site fills up.

10. Offshore pipeline

CO₂ is transported offshore by pipeline to a depleted gas field for long term storage.