Air Emissions

BP Refinery
Kwinana, Western Australia

Through modern treatment processes and reduction programs, air emissions from BP's Kwinana Refinery have significantly reduced in the last decade.

Refining crude oil into the products that provide the energy for our daily lives is a complex process. A result of this process is the production of waste gases. Some waste gases can be used in other parts of the Refinery but sometimes the only safe way to handle waste gases is to release them to atmosphere. A major focus of the Refinery's environmental responsibilities is to ensure that the Refinery's waste gases do not impact on human health or the environment. This assurance is part of BP's global objective to ensure that no environmental harm occurs as a result of our activities.

What's in the Refinery's air emissions?

Crude oil is primarily a mixture of carbon, hydrogen, oxygen, sulfur, and nitrogen compounds. The Refinery is designed to convert crude oil into specific hydrocarbon compounds. Waste gases are generated at the Refinery both through the production of essential utilities such as heat and steam, and through refining the crude oil itself.

The significant waste gases that result from the Refinery's operations are:

1. Sulfur Dioxide (SO_2)
2. Particulates
3. Hydrogen Sulphide (H_2S)
4. Nitrogen Oxides (NO_x: NO & NO_2)
5. Carbon Monoxide (CO)
6. Carbon Dioxide (CO_2)
7. Volatile Organic Compounds (VOCs)

Sources of air emissions at the Refinery

There are four main sources of air emissions from the Refinery, most of which emit similar types of waste gases:

1. Flares

The Refinery's two flares provide a safe pressure relief system in case of process upsets. In the event of an incident at the Refinery, excess gas can be safely diverted to the flares, protecting staff and equipment. Each flare has a continuous flame that safely combusts the gases into carbon dioxide and water.

2. Furnaces

The refining process requires a precise balance between pressure and temperature, both of which are supplied by furnaces. Fuel gas is produced as a supplementary product of refining and the Refinery uses this fuel for energy for the furnaces which heat the hydrocarbons as they flow through the refining units.

3. Residue Cracking Unit

The Residue Cracking Unit (RCU) is one of the most important process units at the Refinery because it can process the heavy, low-value component of the crude oil. The RCU 'cracks' the long chains of hydrocarbons into smaller compounds of greater value.

4. Sulfur Recovery Units

The Refinery has two Sulfur Recovery Units (SRUs) that remove hydrogen sulphide (H2S) from the refinery's fuel gas before the gas is burned in the furnaces. As well as reducing SO2 emissions, the H2S is converted into liquid sulphur which is on-sold for use in industrial processes and to manufacture agricultural fertilisers.

How the Refinery manages its air emissions

Through modern treatment processes and reduction programs, the Refinery's air emissions have significantly reduced in the last decade. Emissions are strictly controlled by the Department of Environment and Conservation (DEC). The Department has set rigid limits on the emissions from local industries, which are monitored both by the DEC and the industries themselves.

Sulfur Dioxide

The main sources of sulfur dioxide emissions from the Refinery are the Residue Cracking Unit and the Sulfur Recovery Units. Over the past 30 years the Refinery has introduced many new treatments and procedures to reduce its sulfur dioxide emissions. In 1985 the Refinery changed its furnace feedstock from fuel oil to natural gas and, in 1989, installed two Sulfur Recovery Units (SRUs) that remove up to 70 tonnes per day of sulfur from the Refinery's fuel gas.

BP has made a commitment to control the amount of sulphur emitted during the use of its products, as part of the Federal Government's Clean Fuels program. The program requires lower sulphur petrol and diesel to be used across Australia. The Refinery's involvement in the Clean Fuels project is predicted to prevent 5,800 tonnes of sulphur dioxide entering the Perth airshed each year.

Hydrogen Sulphide

Hydrogen sulphide enters the Refinery in the crude oil and is removed during the refining process to ensure no hydrogen sulphide is present in the finished product or emitted to air. Hydrogen sulphide is converted to elemental sulphur which is then used in the manufacture of fertiliser products. Any hydrogen sulphide present in fuel gas is burnt in the furnaces. The Refinery treats hydrogen sulphide with extreme care, continuously monitoring emissions from the Sulphur Recovery Units.

Nitrogen Oxides

The major source of NOxs in urban areas is motor vehicles. Industry is a comparatively minor source with the Refinery contributing 1.06% of the total NOx emissions to the Perth airshed in 2009. Despite the relatively low emissions, the Refinery has taken action to reduce NOx emissions by using natural gas rather than fuel oil as furnace fuel, and replacing traditional furnace burners with low-NOx furnace burners.

Carbon Monoxide

Carbon monoxide is generated by the incomplete combustion of carbon products and fossil fuels. In urban areas, virtually all of the carbon monoxide is produced from vehicle emissions and wood-fired heaters.

The Refinery produces carbon monoxide from furnaces, flares, the CO Burner and the Sulfur Plants. Emissions from the furnaces and flares are relatively small and cannot be further prevented due to CO being a byproduct of combustion. The CO Burner is the main source of CO from the Refinery during the removal of coke (mostly carbon) from the Residue Cracking Unit catalyst. Emissions from this source are managed through maintaining the reliability of the unit, as the CO Burner reduces CO emissions from the RCU from 75tonnes/day to 0.57tonnes/day when operational. The oxygen levels in the CO Burner must also be carefully controlled as this determines the reaction of CO to CO_2.

What's in the Refinery's air emissions?

Carbon Dioxide

The Refinery is designed to limit carbon losses however some losses will occur because, at high temperatures, carbon is converted to coke, which fouls the refining units and must be removed. Additionally, the production of carbon dioxide in furnaces through the combustion of carbon compounds in the fuel is an unavoidable consequence of fuel combustion.

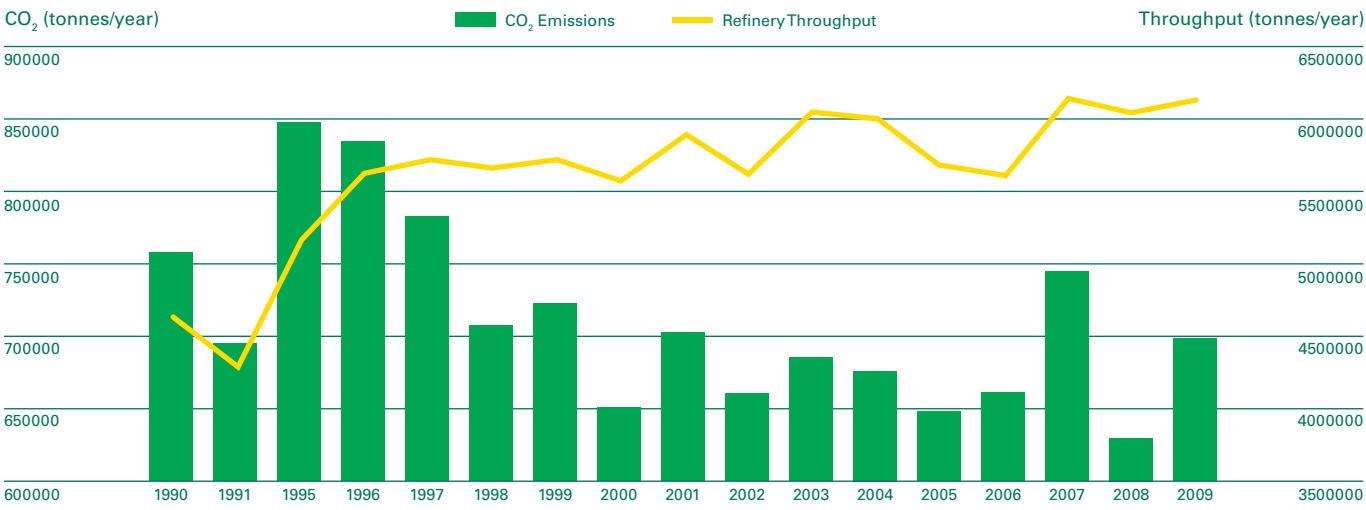
The Refinery introduced an Energy Efficiency Strategy in 1997, that manages CO2 emissions. Emissions are monitored and projects implemented to reduce specific direct or indirect causes of CO2 emissions. Direct emissions are those made from the Refinery stacks and furnaces, and indirect emissions are those that are emitted by other industries that provide the Refinery with utility services such as steam and electricity.

** For more information on BP's response to climate change, see the Carbon brochure.

Projects that have helped reduce carbon emissions through improved energy efficiency include:

- In 1996 the Refinery and Mission Energy Limited joint commissioned the Cogeneration Plant. The plant saw the Refinery change to energy and steam derived from natural gas, instead of oil and coal. The Refinery's indirect CO2 emissions reduced by 160,000 tonnes and, following the decommissioning of onsite boilers, direct emissions reduced by 39,000 tonnes. The project had the additional benefit of providing its surplus power to the state electricity grid.
- In 1997 the Refinery introduced a 'no economic flaring' policy. By optimising the plant throughputs and fuel gas usage, and increasing fuel gas sales, the Refinery reduced CO2 emissions by about 16,600 tonnes per annum.
- As part of the Energy Efficiency Strategy, the impact of energy use and carbon reduction is embedded in the design of all new projects. Success stories have included the diesel hydrotreater unit built in 2005 which, at the time, had the best furnace of all BP furnaces globally. More recently, an upgrade to the LPG facilities and the low-sulphur diesel units were also carried out under the Energy Efficiency Strategy.

CO_2 Emissions from BP Refinery (Kwinana) tonnes/year



What's in the Refinery's air emissions?

Volatile Organic Compounds

The Refinery is working to reduce the amount of VOCs that are emitted from the its storage tanks, sewer, process units and leaking valves/flanges. There are approximately fifty thousand flanges, valves, seals and other fittings that, under certain conditions, will emit volatile hydrocarbon products.

In 1995 the Refinery started a VOC reduction program to reduce emissions to one quarter of 1994 levels by the end of 1998, based on capital investment in best available technology, improvements in process design and education of refinery personnel. The VOC reduction program also involves the systematic leak detection and repair of any fittings that emit fugitive VOCs. In recent years, the Refinery has had considerable success at identifying leaky fittings and replacing these with more reliable equipment, including the Environmentally Friendly Valve design, which tests proved to provide the best seal to prevent VOC fugitive leaks.

Between 1995 and 2006 the Refinery set itself more challenging and decreasing VOC emissions targets which drove the gradual decrease in emissions over that time. The VOC program has also stimulated a number of other improvements in plant design around the Refinery.

* A long-term program to provide all floating roof tanks with secondary seals and to convert the tank stillwells to more effective design.
* Modifications to process units to reduce hydrocarbons venting to atmosphere.
* The refinery now has a policy to repair major leaking valves within seven days.

Particulates

The major source of particulates emissions from BP Kwinana is the Residue Cracking Unit (RCU). Coke forms on the catalyst in the RCU, which fouls the refining process. The waste gases generated during the removal of the coke are discharged through the RCU's stacks. However due to the high velocities and temperatures of the waste gas, particulates become entrained in the gas flow. To reduce particulate emissions, cyclones have been installed on the RCU's stacks. Cyclones create a centrifugal force that physically separates the particulates from the rest of the gas. Over the last ten years significant improvements have been made in reducing particulate emissions from the RCU. In 2004 the Refinery commissioned the Pall Filter with the aim to virtually eliminate visible emissions from Regenerator 2 (R2). Prior to installation of the filter, fine catalyst dust particles formed a visible plume from the stack. Commissioning of the filter has eliminated all visible catalyst dust emissions to the atmosphere from the R2 stack.

VOC Emissions by BP Refinery Kwinana