NSW GOVERNMENT

CLEANAIR FOR NSW

THE COAL CHAIN

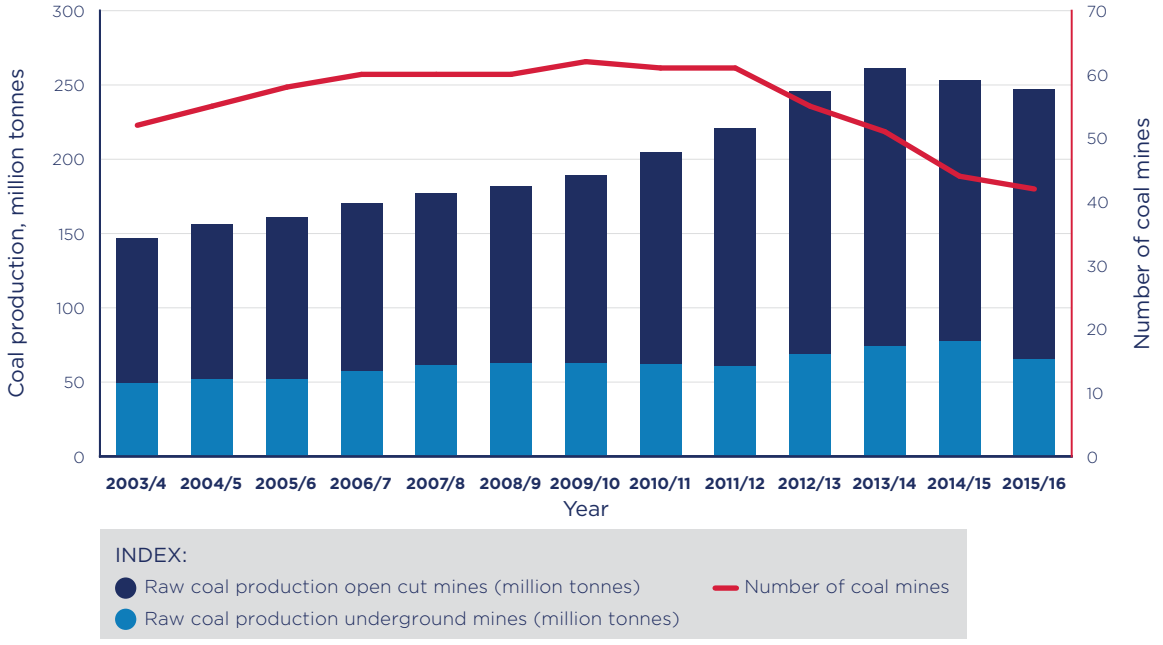
The ‘coal chain’ describes the steps, points and stages in the extraction, processing, transporting, storing and use or export of coal from the mine to a ship or power plant. The coal chain includes the mine site, loading, processing, transport (via train, truck or conveyor), shore based handling of coal stockpiles and shipping or feeding of coal to power stations[1].

In 2016 there were 42 coal mines in NSW producing 246 million tonnes of raw or ‘run-of-mine’ (ROM*) coal, 181 million tonnes of which was from open cut mines. Coal production in New South Wales increased steadily to 2013–14 but has dropped in the two years since 2013–14.[2]

Coal chain activities are collectively a major source of oxides of nitrogen (NO_x), particulate matter (PM) and sulfur dioxide (SO_2), including fugitive dust from mining activities, off-road diesel engines and equipment such as those used in mines and ports, locomotives used for transporting coal to export terminals and domestic coal-fired power stations.

* ROM or raw coal is the coal produced by a mine before any processing

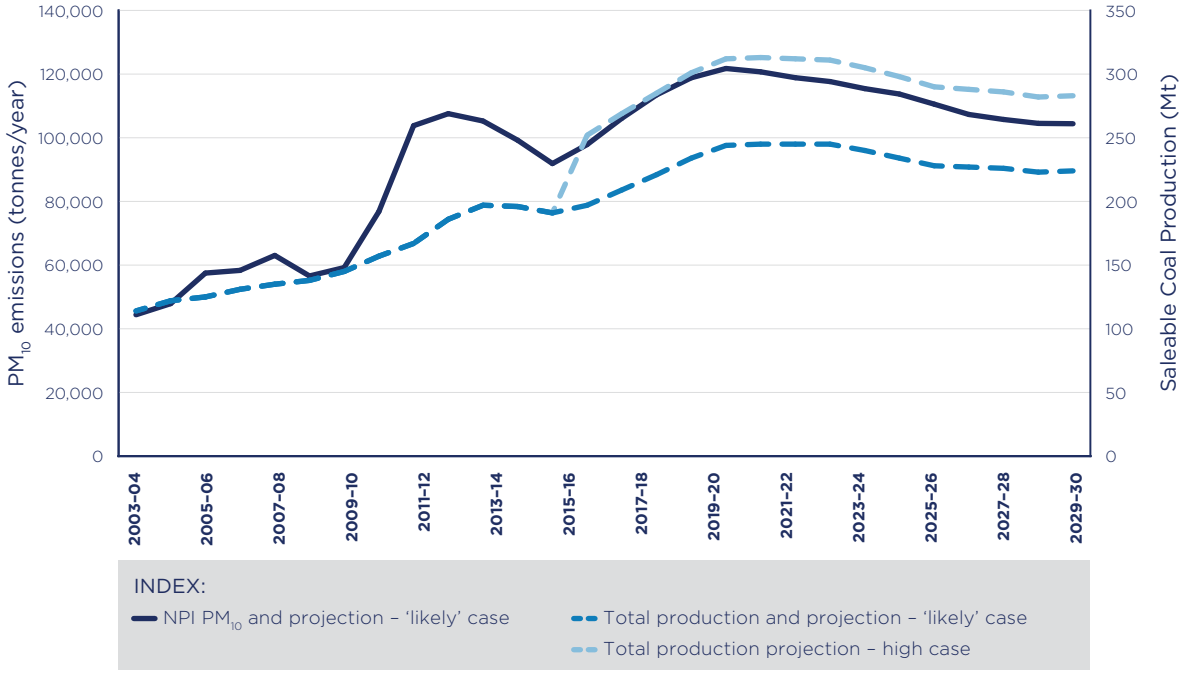
COAL PRODUCTION IN NSW



EMISSIONS FROM COAL MINES

Estimated PM_{10} dust emissions from NSW coal mines peaked over 100,000 tonnes/year in 2011–12 and have steadily declined since. Based on the assumption that PM_{10} fugitive dust emissions will be directly proportional to production, emissions will increase through to 2020–22, and then gradually decrease.[3]

NSW COAL MINING PM_{10} EMISSIONS VS SALEABLE COAL PRODUCTION 2003–04 TO 2015–16 AND PROJECTION TO 2030/31



WHERE DO PARTICLES IN THE AIR WE BREATHE COME FROM?

The NSW Government has been investigating sources of airborne particles in the Lower and Upper Hunter regions.

Results for the Lower Hunter Particle Characterisation Study (PCS) study show that coal contributes up to 10% of $PM_{2.5-10}$ particles in the air. The Coal Grain Analysis study found that coal contributes up to 0.5% of $PM_{2.5}$ particles.

Sea salt was found to be a large contributor of both $PM_{2.5}$ and $PM_{2.5-10}$, particularly at sites like Stockton on the coast.[4]

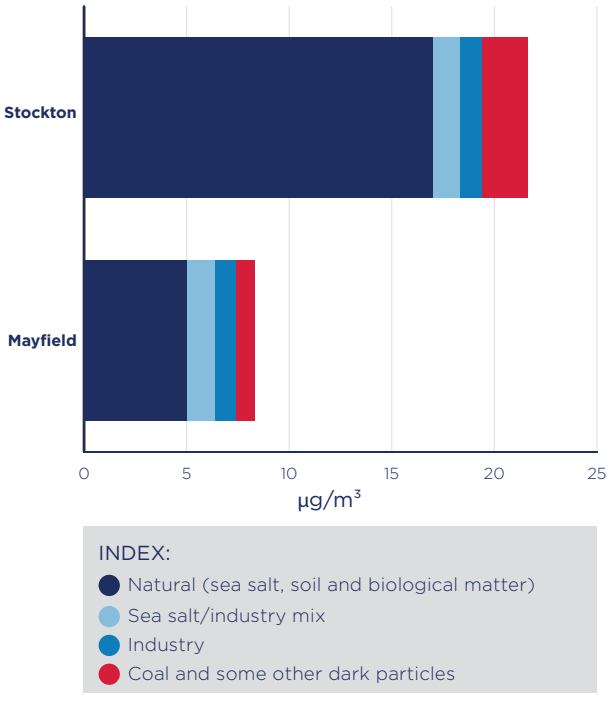
Industry and vehicles were found to be a significant contributor of $PM_{2.5}$.

$PM_{2.5-10}$ are particles with diameters 2.5–10 micrometres (µm)

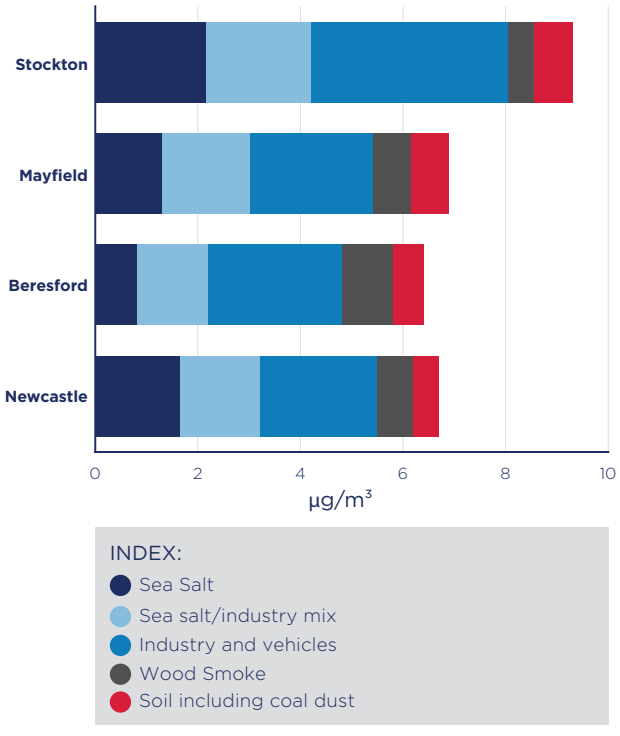
$PM_{2.5}$ are particles with diameters less than 2.5µm

PM_{10} represents all particles with diameters less than 10µm (including $PM_{2.5}$).

LOWER HUNTER PCS $PM_{2.5-10}$ ANNUAL AVERAGES



LOWER HUNTER PCS $PM_{2.5}$ ANNUAL AVERAGES

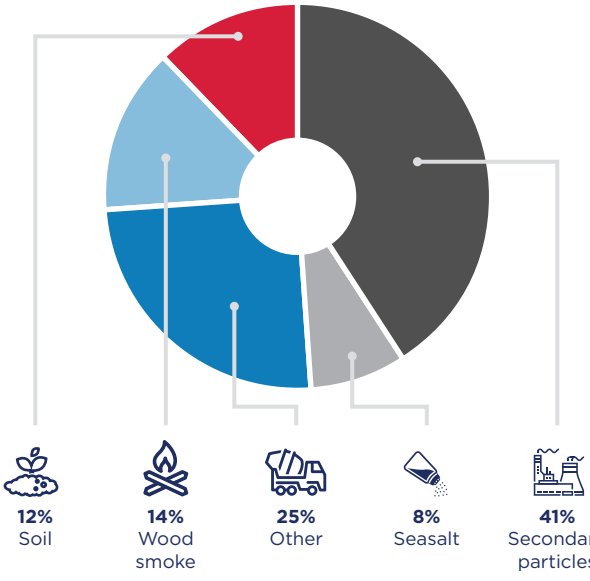


A similar study was undertaken in the Upper Hunter investigating $PM_{2.5}$ in Singleton and Muswellbrook.[5]

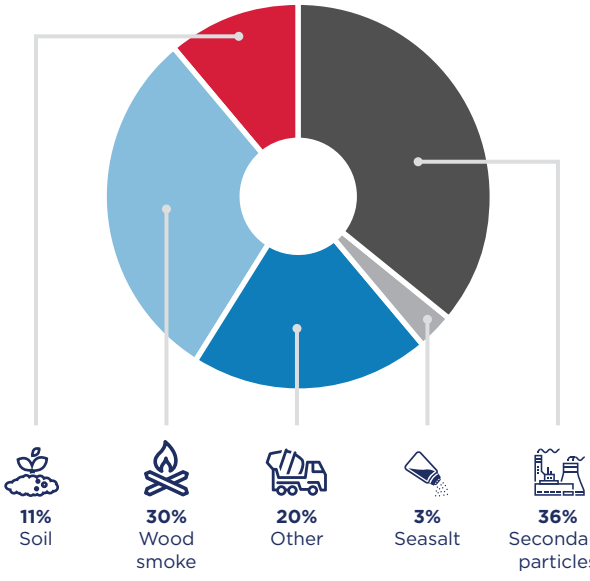
The amount of black carbon in the soil which may result from coal dust emissions is 1 per cent of total $PM_{2.5}$ at Singleton, and 4 per cent of total $PM_{2.5}$ at Muswellbrook.

The black carbon in the soil may also include particles from non-road diesel vehicle emissions that are re-suspended during mining activity.

SINGLETON 2012 $PM_{2.5}$ EMISSIONS SOURCES



MUSWELLBROOK 2012 $PM_{2.5}$ EMISSIONS SOURCES



EMISSIONS FROM COAL-FIRED POWER STATIONS

Coal consumption in NSW power stations peaked in 2008, and declined by 18% in 2013.[6]

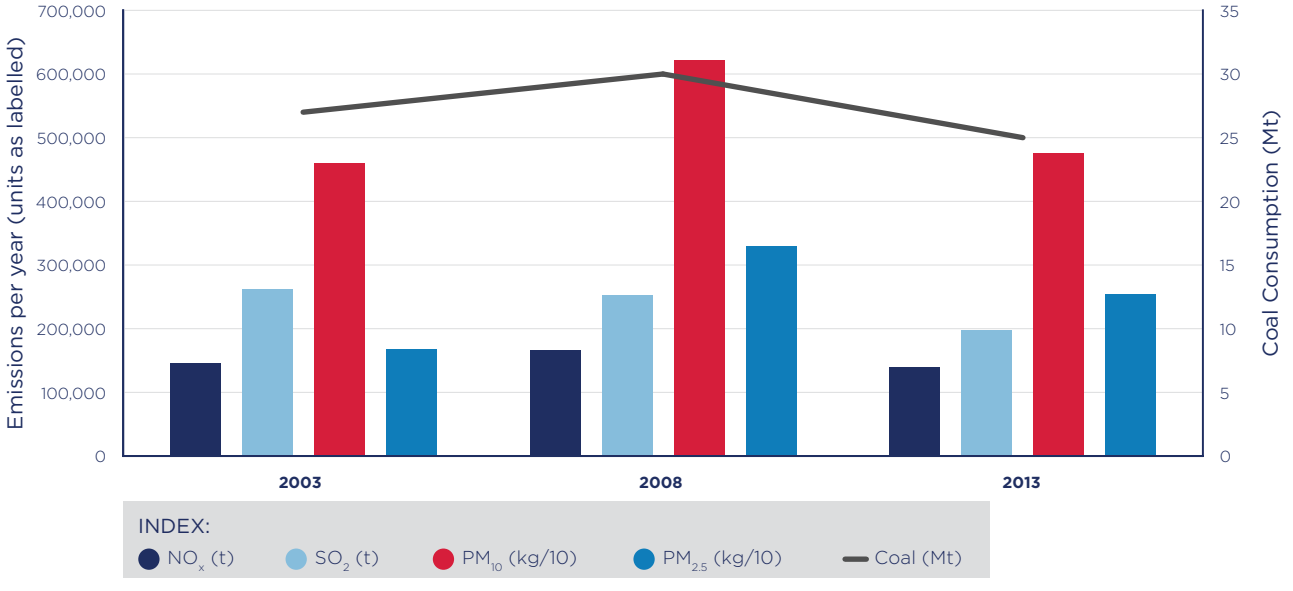
Estimated emissions of NO_x, PM_{10}, $PM_{2.5}$ and SO_2 all decreased from 2008 to 2013.[7]

EPA licence conditions for power stations include stack emission concentration limits for NO_x, PM, sulfuric acid mist and SO3, and various metals such as mercury and other compounds.

The five coal-fired power stations operating in NSW are all fitted with fabric filters, which are Best Available Control Technology for PM emissions and reduce particle emissions by an order of 99.9%.

Coal-fired power station emissions also contribute to the formation of secondary particles, which can be transported and impact air quality across regions.[8]

NSW COAL FIRED POWER STATIONS



EMISSIONS FROM NON-ROAD DIESEL ENGINES AT COAL MINES

Non-road diesel equipment is the largest unregulated source of human made particulate matter (PM) and NO_x emissions in the Greater Metropolitan Region.

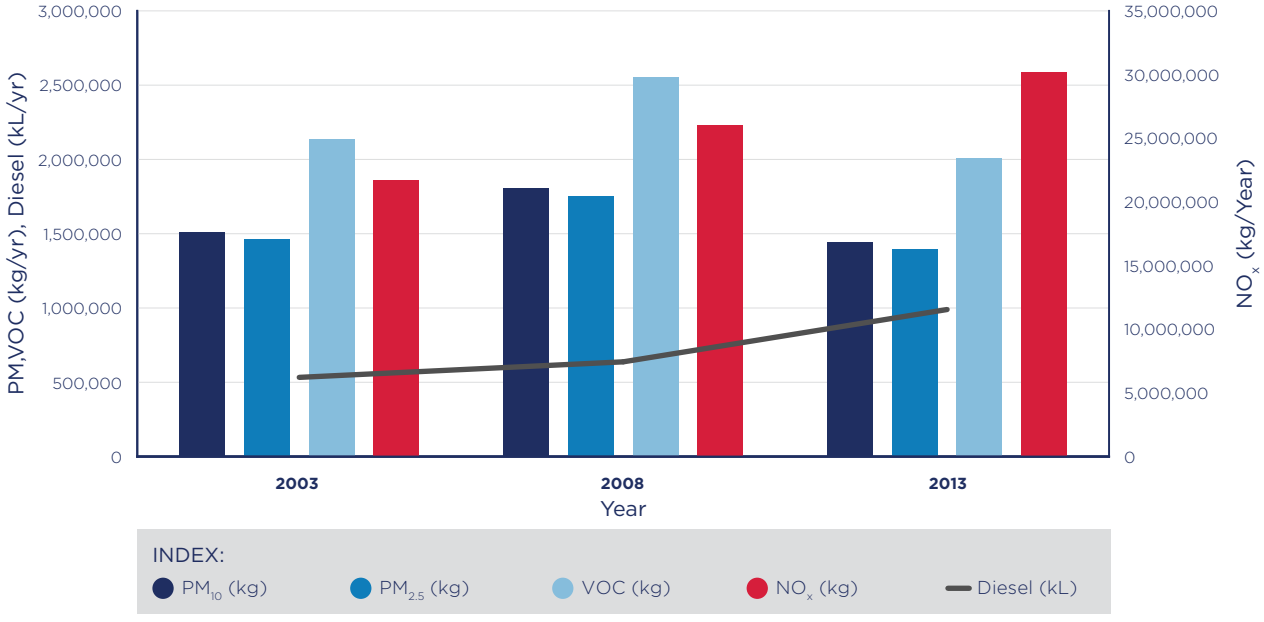
Non-road diesel equipment at coal mines consumes 85–90% of the total diesel used in all non-road diesel equipment in the GMR. Although non-road engines consume less fuel in total than on-road vehicles, they produce more than double the $PM_{2.5}$ emissions (10% of total man-made $PM_{2.5}$ compared to 4%).[9]

Exhaust emission standards for non-road diesel equipment are in place in other OECD economies.

Most open cut coal mining equipment purchased in the last 5–10 years in Australia is fitted with engines that are mechanically identical to US Tier 1 or Tier 2 certified engines.

Tier 4 engines are being developed now and will emit a third to a quarter less PM, and half to a quarter less NO_x compared with engines in the existing coal mining fleet. Tier 4 engines are required for all new equipment sold in the US and Canada from Jan 1 2018, and in Europe from 2019.

COAL MINE INDUSTRIAL OFF-ROAD DIESEL EMISSIONS



LOCOMOTIVES: EMISSIONS FROM DIESEL ALONG THE RAIL CORRIDOR

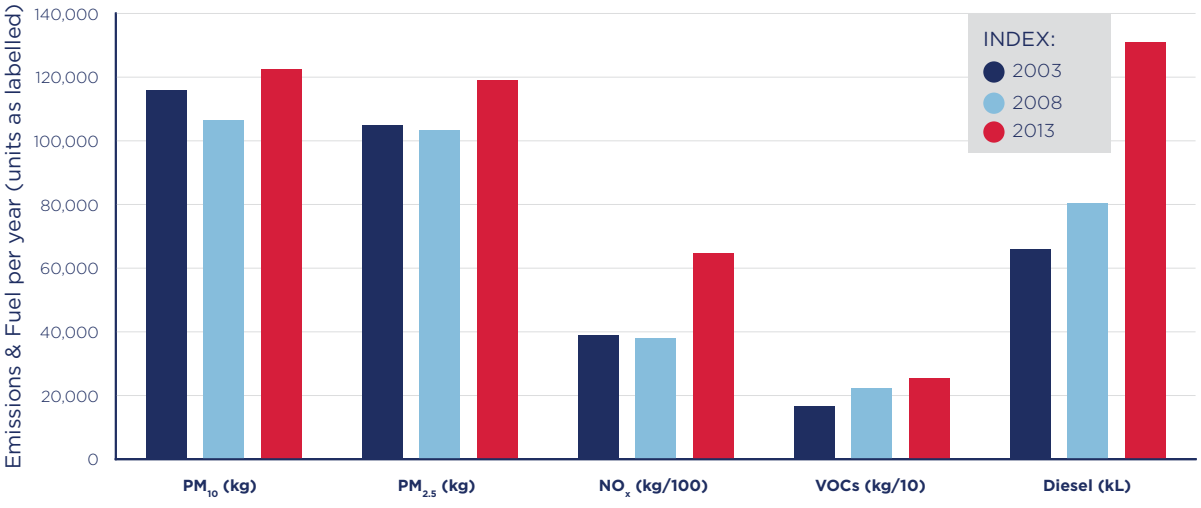
Coal transport in the Hunter region results in a high level of locomotive movements.

In Australia, exhaust emissions from locomotives are unregulated.

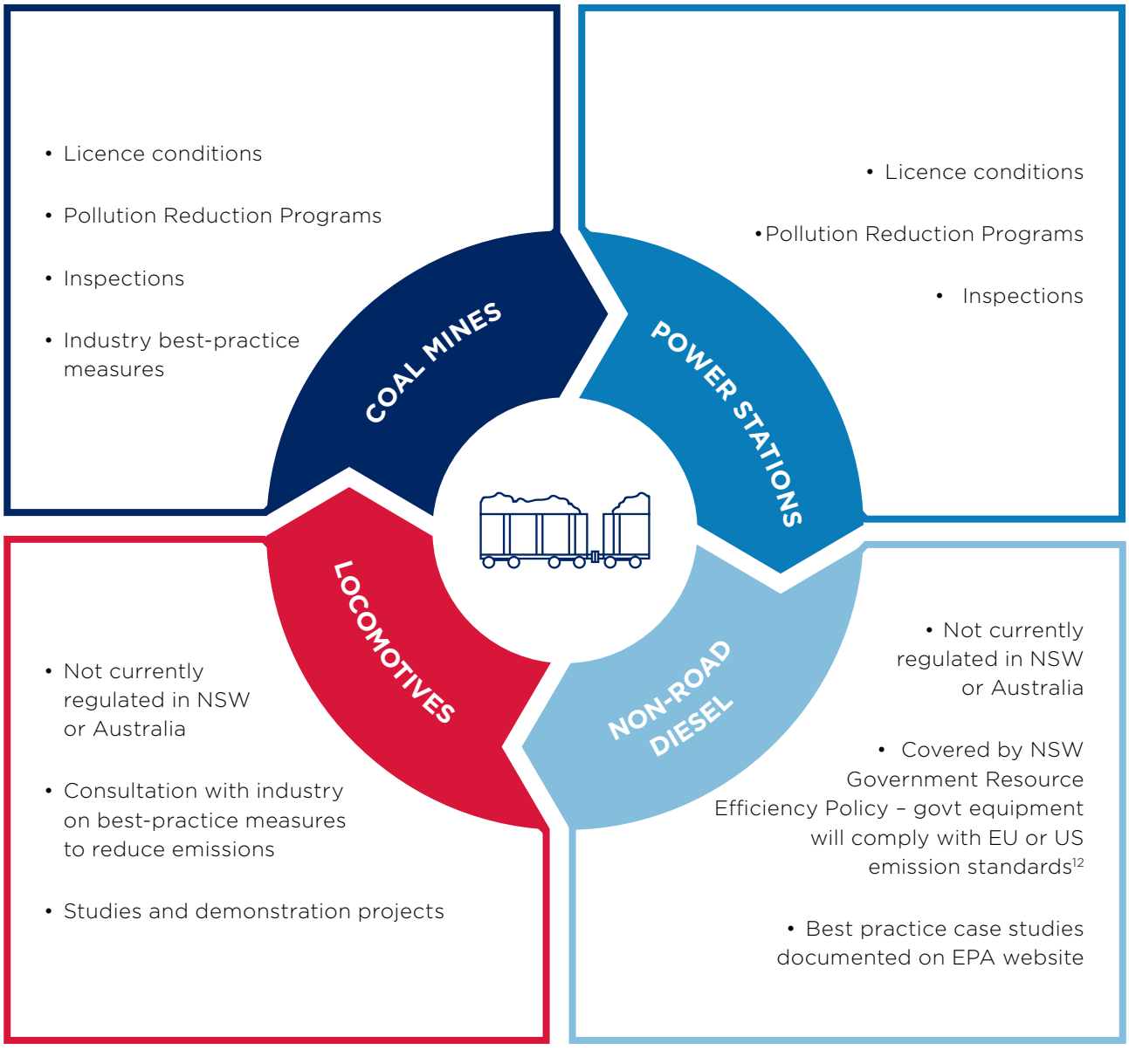
Each locomotive has a service life of approximately 20-30 years so the turnover of fleets and uptake of new cleaner technology is gradual.

Most locomotives used in Australia have been manufactured using US engine systems so there is potential for emission upgrade technology developed to meet US regulations to be integrated into locomotive fleets in NSW. Some operators have purchased locomotives that conform to US Tier 1 and Tier 2 standards in recent years.[10]

LOCOMOTIVE EMISSIONS FROM THE HUNTER VALLEY COAL NETWORK[11]



THE COAL CHAIN EMISSIONS MANAGEMENT FRAMEWORK



1 NSW Chief Scientist and Engineer (2016), Final Report on the Independent Review of Rail Coal Dust Emissions Management Practices in the NSW Coal Chain http://www.chiefscientist.nsw.gov.au/reports/review-of-rail-coal-dust-emissions

2 Coal Services (2014) NSW coal mine statistics by quarter and financial year summaries, Coal Services (2016), Coal Services Annual Report 2016, Coal Services, PO Box 3842, Sydney, NSW 2001, Australia. http://www.coalservices.com.au/annualreports.aspx

3 Data calculated from Coal Services Annual Reports 2014-2016 and NPI (2017), National Pollutant Inventory, Search by Form, Department of the Environment and Energy, GPO Box 787, Canberra, ACT 2601, Australia. http://www.npi.gov.au/. Projections based on EPA (2013) NSW Coal Mining Benchmarking Study http://www.epa.nsw.gov.au/resources/air/150242-coal-mine-study.pdf

4 A range of studies were undertaken and are available at http://www.environment.nsw.gov.au/aqms/lowhunterparticle.htm Sea salt at Stockton is discussed in Our Local Air Quality: Findings from the Lower Hunter Particle Characterisation Study, pp. 4&7. http://www.environment.nsw.gov.au/resources/air/lower-hunter-particle-study-summary-160256.pdf

5 OEH/CSIRO (2013), Upper Hunter Valley Particle Characterisation Study http://www.environment.nsw.gov.au/aqms/uhaqmnfpcs.htm

6 EPA Air Emissions Inventories 2003, 2008, 2013 (provisional) http://www.epa.nsw.gov.au/air/airinventory.htm

7 EPA Air Emissions Inventory 2008, 2013 (provisional)

8 Cohen DD, Crawford J, Stelcer E & Atanacio AJ (2012) Application of positive matrix factorization, multi-linear engine and back trajectory techniques to the quantification of coal-fired power station pollution in metropolitan Sydney, Atmospheric Environment 61 (2012) pp204-211.

9 NSW Air Emissions Inventories 2003, 2008 & 2013 (provisional)

10 Based on EPA Air Emissions Inventories 2003, 2008, 2013 (provisional)

11 Based on EPA Air Emissions Inventories 2003, 2008, 2013 (provisional)

12 State of NSW and OEH (2014) Government Resource Efficiency Policy http://www.environment.nsw.gov.au/government/policy.htm