2. DESCRIPTION OF THE PROPOSED PROJECT

In order to be able to adequately provide for the growing electricity demand, Eskom propose to construct a new power station with a maximum capacity of 4 800 MegaWatts (MW) in the Lephalale area in the vicinity of the existing Matimba Power Station. Currently the project name for the new proposed power station is Matimba B, but the name will be changed should the project be approved. The power station will be coal-fired, and source coal from local coalfields.

2.1 The Proposed Matimba B Power Station

Matimba B Power Station is proposed to ultimately have a maximum installed capacity of up to 4800 MW, but the first phase to be constructed and operated will be approximately half that installed capacity. The exact output will depend on the specification of the equipment installed and the ambient operating conditions. The footprint of the proposed new power station is still to be determined through final engineering and design, but has been indicated by Eskom that the new facility will be similar in size (ground footprint) to the existing Matimba Power Station. The power plant and associated plant (terrace area) would require an area of approximately 700 ha, and an additional approximate 500 - 1000 ha would be required for ancillary services, including ashing facilities (alternate ash disposal options are, however, currently being investigated).

It is envisaged that the proposed power station will utilise a range of technologies pertaining to cooling, combustion and pollution abatement. The environmental studies undertaken will assist in determining these. The proposed power station would be a dry-cooled station. The use of dry-cooled technology is necessitated as a result of the water availability in the area. The power station would be a zero liquid effluent discharge station, and would monitor emissions to air on a continuous basis.

The power station would source coal from the local coalfields, and it would be delivered to the power station via conveyor. The Grootegeluk Colliery, which also services the existing power station, is located to the immediate west of Matimba Power Station. An estimated 7 million tonnes per year of coal is required in order to supply the proposed power station.

The proposed Matimba B Power Station is proposed to be constructed and commissioned in phases in order to meet the growing demand of electricity. Appropriate technology alternatives have been investigated by Eskom from a technical and economic feasibility perspective through pre-feasibility studies. All Eskom's existing operational power stations utilise pulverised fuel technology (PF). The first phase of Matimba B is proposed to consist of 3 units, each with a nominal installed capacity of between approximately 700 and 800 MW, pulverised fuel combustion. The second phase (timing, capacity and technology) will be decided upon in due course through the Eskom planning processes. The preferred technology will be nominated based on the findings of Eskom's feasibility studies (technical and economic). The decisions regarding technology alternatives will determine the number of units required and exact output, as this is dependant on the specification of the equipment and the ambient operating conditions.

The proposed power station would be similar to the existing Matimba Power Station in terms of operation, design and dimensions. The power station structure would be approximately 130 m high and approximately 500 m wide. The required stacks would be approximately 200 m in height. Should direct-cooling technology be applied, no cooling towers would be required to be constructed. Other related infrastructure would include a coal stockpile, conveyor belts, and an ash dump, with infrastructure such as transmission lines being planned to integrate the station into the national electricity grid.

The two feasible technology alternatives being considered for the Matimba B Power Station are:

- *Pulverised Fuel Combustion (PF):* Coal is first pulverised then blown into a furnace where it is combusted at high temperatures. The resulting heat is used to raise steam, which drives a steam turbine and generator.
- *Fluidised Bed Combustion (FBC):* Coal is burnt in a furnace comprised of a bed through which gas is fed to keep the fuel in a turbulent state.

Technology alternatives are discussed further in section 2.4.

2.1.1 How is electricity generated?

The process of generating electricity within a power station can be summarised as follows:

- **Fuel:** Coal is fed from the coal mine to a stockpile at the power station via conveyor belts. Coal is fed into pulverising mills which grind the coal to dust. A stream of air blasts this powdered coal to the boiler burners in the furnace where it burns like a gas. More coal is required with increased capacity.
- **Boiler:** Heat released by the burning coal is absorbed by many kilometres of tubing which form the boiler walls. Inside the tubes, water is converted to steam at high temperature and pressure.
- **Steam turbines:** This superheated steam passes to the turbines where it is discharged onto the turbine blades. The energy of the steam expanding in the turbines causes the turbine to spin.

- **Generator:** Coupled to the turbine shaft is the rotor of the generator. The rotor is a cylindrical electromagnet which spins inside large coils of copper to generate electricity.
- **Transmission:** The electricity produced passes from the generator to a transformer where the voltage is raised to the transmission voltage of 400 kV.
- **Cooling:** After exhausting its energy in the turbines, the steam in the boiler water circuit is required to be condensed so that it can be pumped back to the boiler for reheating.

2.2 Project Alternatives

In terms of the Environmental Impact Assessment (EIA) Regulations, feasible alternatives are required to be considered within the Environmental Scoping Study. All identified, feasible alternatives are required to be evaluated in terms of social, biophysical, economic and technical factors.

A key challenge of the EIA process is the consideration of alternatives. Most guidelines use terms such as 'reasonable', 'practicable', 'feasible' or 'viable' to define the range of alternatives that should be considered. Essentially there are two types of alternatives:

- incrementally different (modifications) alternatives to the project; and
- fundamentally (totally) different alternatives to the project.

Fundamentally different alternatives are usually assessed at a strategic level, and EIA practitioners recognise the limitations of project-specific EIAs to address fundamentally different alternatives. Any discussions around this topic have been addressed as part of the Integrated Strategic Electricity Plan (ISEP) undertaken by Eskom, as well as the National Integrated Resource Plan (NIRP) from the National Electricity Regulator (NER). Environmental issues are integrated into the ISEP and the NIRP using the strategic environmental assessment approach, focussing on environmental life-cycle assessments, site-specific studies, water-related issues and climate change considerations. This Scoping Study, thus, only considers alternatives considered in terms of the proposed new coal-fired power station in the Lephalale area, and does not evaluate any other power generation options being considered by Eskom.

2.2.1. The 'Do Nothing' Alternative

The 'do-nothing' alternative is the option of not establishing a new coal-fired power station at a site in Lephalale, Limpopo Province.

The electricity demand in South Africa is placing increasing pressure on Eskom's existing power generation capacity. South Africa is expected to require additional peaking capacity by 2007, and baseload capacity by 2010, depending on the average growth rate. This has put pressure on the existing installed capacity to be able to meet the energy demands into the future. The 'do nothing' option will, therefore, result in these electricity demands not being met in the short-term. This has serious short- to medium-term implications for socio-economic development in South Africa.

Without the new proposed coal-fired power station in Lephalale, an alternative means of generating an additional 4 800 MW capacity would be required to be sought from another power generation source. Such alternatives include amongst others, investigating and promoting energy efficiency, researching and demonstrating renewable energy, as well as the optimal use of operating power stations.

Eskom have identified that a wide range of capacity options are required to be developed simultaneously in order to successfully meet the future electricity needs of South Africa. Alternative energy sources such as gas and wind power may have benefits in terms of some biophysical and social aspects, but must be considered in terms of cost, efficiency, available timeframes and associated environmental impacts.

Without the implementation of this project, the electricity network will not be able to function at full capacity, and the greater power supply will be compromised in the near future. This has potentially significant negative impacts on economic growth and social well-being. Therefore, the no-go option is not considered as a feasible option on this proposed project.

2.3 Location Alternatives for the Establishment of a New Coal-fired Power Station within South Africa

In determining the most appropriate site for the establishment of a new coal-fired power station within South Africa, various options were investigated by Eskom through the IEP process. This site selection process considered the following criteria:

- the availability and accessibility of primary resources required for the operation of the power station, such as coal, water and sorbent;
- availability of land to locate the site and associated ancillary infrastructure;
- the availability and accessibility of infrastructure for the provision of services, manpower and social structure for the construction and operation of the power station;
- the ease of integration of the new power station into the existing National Transmission network/grid and the environmental impacts associated with this integration; and

- general environmental acceptability in terms of social impacts, air quality, water utilisation, general ecology, etc.

Through a series of feasibility and high-level screening studies undertaken by Eskom within which the above criteria were evaluated, the Lephalale area in the vicinity of the existing Matimba Power Station ranked as the most favourable site for the establishment of a new coal-fired power station. This decision was as a result of, *inter alia*:

- land availability in close proximity to the primary coal source;
- the properties of the coal mined are well known due to the experience acquired through the existing Matimba Power Station;
- competitive coal prices from Grootegeluk Mine; and
- alternative ash disposal options available (in consultation with Grootegeluk Mine).

2.4 Site Alternatives Identified within the Lephalale Area for the Establishment of a New Coal-fired Power Station

A strategic analysis was undertaken by Eskom in order to identify feasible alternative sites for the establishment of the proposed new power station (terrace) and associated infrastructure within the Lephalale area. This analysis considered technical, economic and environmental criteria. From a high-level screening study undertaken in 1998, it was concluded that there was the potential to establish a new power station in close proximity to the existing Matimba Power Station. In order to minimise the technical and environmental costs associated with the transportation of the fuel source to the power station, it was determined that the most feasible sites would be close to the existing Grootegeluk Mine. Criteria in terms of sterilisation of coal resources and major risks to the operations of the Mine or existing power station were also taken into consideration.

A significant concern in terms of the siting of a new power station in close proximity to the existing Matimba Power Station was the risks associated with interference from the cooling system of one site on the other. In this regard significant analysis was necessary to determine the potential influence of the proposed power station on the existing Matimba Power Station, and vice-versa prior to finalising the alternative sites identified for investigation.

In addition to the above technical and economic criteria, the selection of potential sites was significantly influenced by the position of two major fault lines within the study area, i.e. the Eenzaamheid and Daarby Faults. In the case of the Daarby Fault the level of coal drops by 300 m from the sub-surface coal found at Grootegeluk Mine. It is considered unlikely that in the life of the power station there will be any mining operations in this area due to the logistics of mining and hence the temporary sterilisation of the land on this site for the life of the power station is not considered to be a limiting factor. No coal exists south of the Eenzaamheid fault.

The sites adjacent to the mine pit were all evaluated, and it was concluded that there were no fatal flaws associated with the farms Eenzaamheid, Nauwontkomen, Nelsonskop and Appelvlakte. Therefore, these would be considered for the establishment of the power station and associated plant (terraced area). The farm Hangklip was considered to be flawed for various reasons, including the fact that the site is currently congested with transmission lines. The Eskom-owned properties of Zongezien and Peerboom were not identified as suitable sites through this analysis mainly as a result of their distance from the existing Mining operations and their location close to existing and planned residential development.

It was further concluded that any other site would be significantly more distant from the mine pit than the four previously identified sites and as such would only be considered at a later stage for the power station development should all four of the identified sites were found to be unsuitable through detailed environmental and technical evaluations.

Through this analysis, the farms Appelvlakte, Nelsonskop, Eenzaamheid and Nauwontkomen were identified as suitable sites for the establishment of the power station or ancillary infrastructure, and in addition Droogeheuvel, Zongezien, Kromdraai and Kuipersbult were also identified as additional suitable sites for the establishment of ancillary infrastructure.

2.4.1 Description of Identified Site Alternatives

The alternative sites identified through the analysis undertaken by Eskom are described below, and indicated on Figure 2.1. The farms Appelvlakte, Nelsonskop, Eenzaamheid and Nauwontkomen have been evaluated in terms of potential impacts associated with the establishment of the proposed power station (terrace). The farms Eenzaamheid, Nauwontkomen, Nelsonskop and Appelvlakte, Droogeheuvel, Zongezien, Kromdraai and Kuipersbult have been evaluated in terms of potential impacts associated with the establishment of ancillary infrastructure.

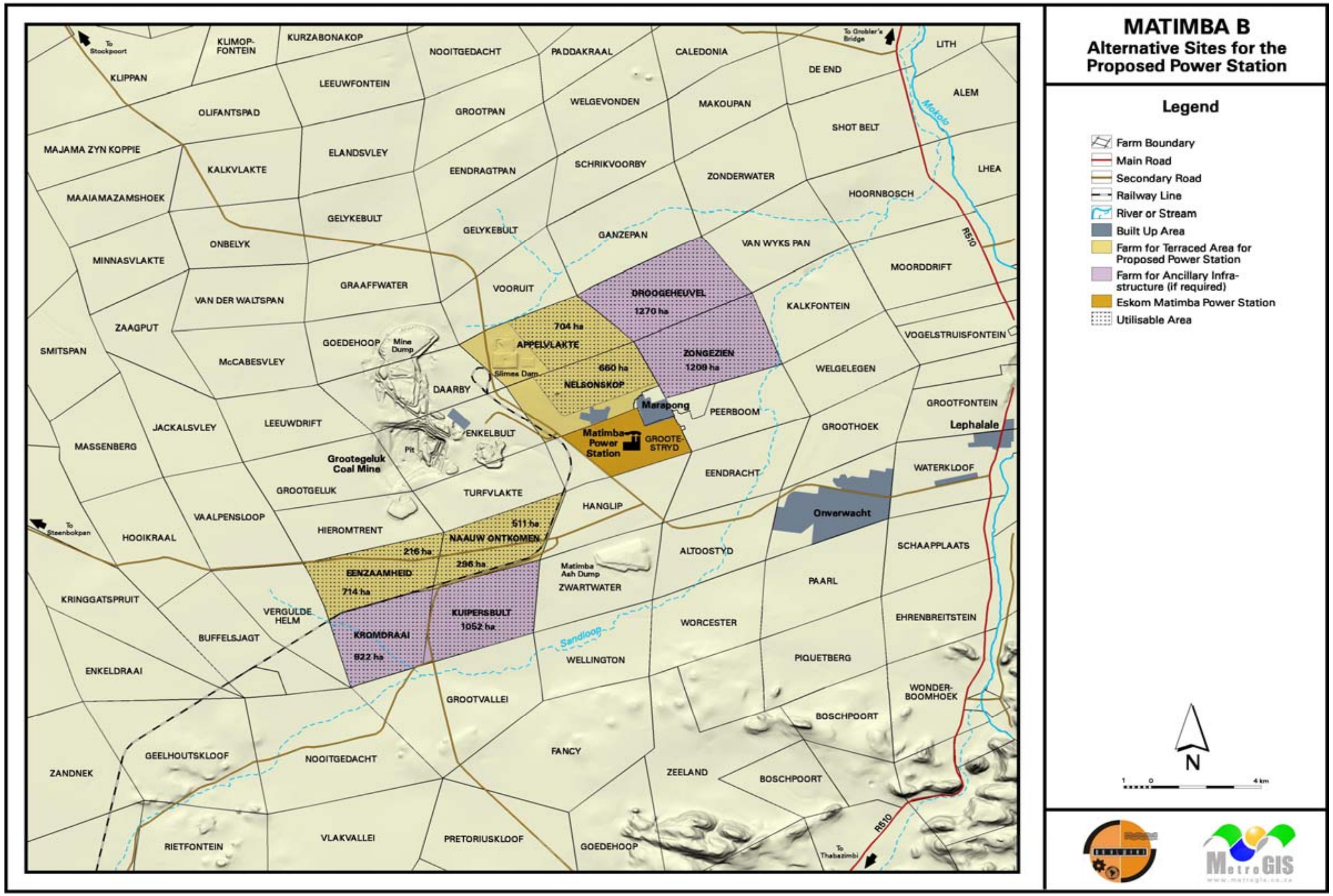

Figure 2.1: A map indicating the locality of the eight alternative sites

* *Farm Appelvlakte 448 LQ:* The farm is owned by Kumba Resources, and is currently used for game farming. The farm has a total extent of ~882 ha, although a portion of the farm is occupied by slimes dams operated by Kumba Resources, rendering ~704 ha as utilisable area. This site is situated 4,3 km from the existing power station, 3,8 km from the Marapong Township and 9 km from Lephalale (Onverwacht Township). There are 8 farmhouses/dwellings within 6 km of the site. The farm Appelvlakte is bordered by the farms Vooruit in the north, Droogeheuvel in the east, Daarby in the West and Nelsonskop in the south. The farm Daarby currently forms part of the Grootegeluk Colliery. The western corner of the farm Appelvlakte is traversed by the Stockpoort Road.

* *Farm Nelsonskop 464 LQ:* The farm is owned by Kumba Resources, and is presently used for game farming. The farm is ~848 ha in extent, with a portion occupied by a sewage works, rendering 660 ha as utilisable area. This site is situated on the northern border of Farm Grootestryd (the existing Matimba Power Station property). To the west of the site is the farm Enkelbult, which currently forms part of the Grootegeluk Colliery and is the farm on which current mining operations are being undertaken. This site lies 1,2 km from the Marapong township and 7 km from Lephalale (Onverwacht Township). The Stockpoort Road is located to the west of the site, traversing the south-western corner. There are 6 farmhouse/dwellings within 6 km of the site. A prominent topographical feature of this site is a sandstone outcrop commonly known as Nelson’s Kop.

* *Farm Naauwontkomen 509 LQ:* The farm is owned by Kumba Resources, and is currently utilised in a breeding programme. The farm is ~807 ha in extent. The site is divided into two smaller portions by the Steenbokpan Road. A railway line runs along the eastern and southern boundaries of the farm. This site lies 4 km from the existing Matimba Power Station, 5,2 km from the Marapong Township and 8,5 km from Lephalale (Onverwacht Township). This site is bordered by the farms Turfvlakte in the north, Hangklip in the east, Kuipersbult in the south and Eenzaamheid in the west.

* *Farm Eenzaamheid 687 LQ:* The farm is privately-owned and is currently used for cattle farming. The farm is ~930 ha in extent, however the farm is bisected by the Steenbokpan Road, which divides the property into two smaller portions. A railway line forms the southern boundary of the property. Surrounding land uses include general farming activities, game farming and mining activities. This site lies 11 km from the existing Matimba Power Station, 12 km from the Marapong Township and 15 km from Lephalale (Onverwacht Township). There are 9 farmshouses/dwellings within 6 km of the site.

* *Farm Droogeheuvel 447 LQ:* The farm is situated adjacent to the Farm Appelvlakte. The farm is privately-owned and is currently used for game farming. The farm is ~1 270 ha in extent. This site is situated approximately 4,3 km from the existing power station, 3,8 km from the Marapong Township and 9 km from Lephalale (Onverwacht Township).

* *Farm Zongezien 467 LQ:* The farm is situated adjacent to the farm Nelsonskop. The farm is currently owned by Eskom, and is used for cattle and game farming by a tenant. The tenant is currently building a new lodge on the farm. The farm is ~1 200 ha in extent. This site lies approximately 2 km from the existing Matimba Power Station, 1,2 km from the Marapong township and 7 km from Lephalale (Onverwacht Township). The site is bordered by the Marapong Township to the south-west.

* *Farm Kuipersbult 511 LQ:* The farm is situated adjacent to the farm Naauwontkomen. The farm is privately-owned and utilised primarily for cattle farming. The farm is ~1052 ha in extent. This site is bordered by a variety of linear infrastructure, road infrastructure borders the farm to the north and west, while a railway line is also found on the northern border of the farm. This site lies approximately 4 km from the existing Matimba Power Station, 5,2 km from the Marapong Township and 8,5 km from Lephalale (Onverwacht Township). Kuipersbult is bordered by the farm Zwartwater, to the east, on which the existing Matimba ash dump is situated.

* *Farm Kromdraai 690 LQ:* The farm is situated adjacent to the farm Eenzaamheid. The farm is privately-owned and is currently utilised for cattle farming. The farm is ~ 922 ha in extent. This site lies approximately 11 km from the existing Matimba Power Station, 12 km from the Marapong Township and 15 km from Lephalale (Onverwacht Township). Road infrastructure borders the farm to the east and rail infrastructure borders the farm to the north. A small tributary of the Sandlopp River traverses this site.

These alternative sites will be evaluated in terms of social, biophysical and economic criteria in order to determine their potential impact on the surrounding environment. A preferred site or combination of sites will be identified for further investigation in the EIA.

2.5 Feasible Technology Alternatives

2.5.1 Cooling Technology

The new power station is proposed to be dry-cooled, largely as a result of the limited water supply in the Lephalale area. This technology is less water intensive than power stations utilising conventional wet-cooling systems. The dry cooled

systems currently used in Eskom utilise <0,2 l/kWh (litres of water per electricity unit sent out), which equates to approximately 3 million cubic metres of water per annum for a typical 2100 MW installed power station. In comparison, wet cooled systems currently used in Eskom, utilise approximately 1.8 litres of water per electricity unit sent out, which equates to approximately 27 million cubic metres of water per annum for a typical 2100 MW installed power station.
Advantages and disadvantages of dry-cooling technology include:

- *Advantages*
  - A dry cooled plant shows no visible wet plumes, e.g. fogs, shadow or ice.
  - This technology assists with water conservation and thus increases plant-siting flexibility.
  - The use of dry cooled units will therefore meet the necessary environmental requirements and subsequent water conservation needs.

- *Disadvantages*
  - Expected 8–10% loss of thermal efficiency, making this technology a more expensive option.

There are two types of equally proven dry cooling systems, namely direct and indirect.

In a direct dry system, the steam is condensed directly by air in a heat exchanger (air cooled condenser) and the condensate is returned to the steam cycle in a closed loop. Most part of the condensation takes place in the condenser section at a near constant temperature, however 2-4°C below the saturation temperature corresponding to the turbine backpressure. Another section of the heat exchanger serves for condensing the remaining steam with higher air content, therefore it takes place in a gradually decreasing temperature with a significantly lower heat transfer coefficient due to the increasing partial pressure of the air. The air flow is induced solely by mechanical draft at all the existing direct air cooled condensers.

With indirect dry cooling, cooled water from cooling tower flows through recovery hydraulic turbines connected in parallel and is used in preferably a direct contact jet condenser to condense steam from the steam turbine. The condensation takes place practically at the temperature corresponding to the turbine backpressure. The mixed cooling water and condensate are then extracted from the bottom of the condenser by circulating water pumps. A portion of this flow - corresponding to the amount of steam condensed - is fed to the boiler feed water system by condensate booster pumps. The major part of the flow, discharged by the circulating water pumps, is returned to the tower for cooling. The cooling deltas (water-to-air heat exchangers) dissipate the heat from the cycle.

Eskom is currently investigating which dry-cooling system will be utilised at the proposed new power station.

2.5.2 Combustion Technology

In terms of combustion technology, the proposed new power station, like the existing Matimba Power Station, is proposed to make use of pulverised fuel (PF) technology. With this technology, coal is first pulverised, then blown into a furnace where it is combusted at high temperatures. The resulting heat is used to raise stream, which drives a steam turbine and generator. Recent advances in technology such as the possibility of using a higher efficiency combustion process (supercritical combustion) will result in the new power station's thermal efficiency being up to 40% (compared to approximately 34% of older power stations), resulting in a reduced environmental impact as less coal has to be burned to produce the same amount of energy.

Fluidised Bed Combustion (FBC) is an alternative technology option under consideration for the additional capacity of the proposed Matimba B Power Station (i.e. to take the station to 4 800 MW). Coal is burnt in a furnace comprised of a bed through which gas is fed to keep the fuel in a turbulent state. FBC technology allows for the use of a lower grade coal, however greater volumes would be required to achieve the same calorific value. The units are typically no larger than 350 MW units, and therefore more units would be required than with PF to achieve the same output. FBC is advantageous that SOx emissions are reduced, however higher CO_2 emissions are higher per unit sent out than if PF is utilised. Flue Gas Desulphurisation (FGD) can be employed on a PF power plant to reduce SOx emissions.