



**The People's Republic of China
Macao Special Administrative Region (Macao SAR)
Audit Commission**



Audit on Climate Change and Air Pollution Prevention



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Introduction

Environmental Audit - Overview

The Audit Commission of Macao SAR was established in December 1999. Although the Audit Commission has yet to conduct any specific environmental audit, it is closely monitoring the execution of related policies and regulations. In preparation for the said audit in the near future, the Audit Commission has assigned dedicated personnel to gather relevant data and carry out analyses.

Environmental Policy of Macao SAR on Climate Change and Prevention of Air Pollution

Overview

➤ **Location**

The Macao SAR is an integral part of the People's Republic of China, situated at the southeast coast of China and the west shore of Pearl River. Macao is 60 kilometers away from Hong Kong SAR and, located at latitude 22°12'14"N and longitude 113°32'22"E. The Macao SAR consists of Macao peninsula and two islands: Taipa and Coloane. Due to reclamation along its coastline, Macao's total land area has increased from the original 11.6 km², recorded in 1912 when measurement was first taken, to the current 29.2 km². Reclamation off the south coast of Taipa island has resulted in the two islands (Taipa and Coloane islands) joining together to form the new Cotai district.

➤ **Climate**

Macao is situated in a subtropical zone, with the Asian continent to the north and a wide tropical sea to the south. In winter, Macao experiences a north wind, cold and dry weather and low rainfall, due to a cold continental high-pressure system at medium and high latitudes. In summer, Macao is mainly subject to southwesterly winds, hot and wet weather and heavy rainfall, due to the influence of oceanic tropical weather system. The reverse of wind directions in winter and summer, together with minimal temperature variations during the day, give Macao a marine monsoon climate.

According to the World Meteorological Organization 30-years-average standard calculation, the average annual precipitation in the Macao SAR between 1971 and 2000 was more than 2,000 mm, with most rainfall occurring between April and

October. May had the most precipitation – an average of 361.9 mm – while January had the least – an average of 32.4 mm.

Macao has an average annual temperature of 22.4°C. The coolest month is January, when it averages 14.8°C. In most years, Macao has a short, cold weather period when temperatures fall below 5°C. The average monthly temperature exceeds 22°C during seven months of the year, indicating the Macao SAR has a short winter but a long summer. Macao is frequently hit by typhoons. The typhoon season starts in May and ends in October, with July and August as its peak period.

➤ **Geology and Topography**

Macao SAR mainly comprises flat land, terraces and hills. The area of flat land (including reclaimed land) is 18.2 km², accounting for 66.6% of the total; granite hills cover 6 km², or 22%; and terraces cover 1.2 km², or 4.4%. The terraces are historically areas of denudation, low elevation (20-25 metres) and gentle slopes mean that most of the terraces are fully utilized. The remaining land – including reserves, mountain sites and forests – occupies approximately 1.9 km², accounting for 7.0% of the total land area.

Administrative Framework

In 1990, the Office of Environmental Technique (Gabinete Técnico do Ambiente), originally an advisory council to the office of the then Macao Governor, was established under the supervision of the then Secretary of Social Affairs and Finance Bureau (Secretário-Adjunto para os Assuntos Sociais e Orçamento) to advise on environmental protection policy setting, coordinate the launch of programs and assist in promotional activities. In June 1998, the Office of Environmental Technique was restructured and renamed as the Environment Council¹. It operates under the supervision of the Secretary for Transport and Public Works with enhanced responsibilities.

The main responsibilities of the Environment Council are:

- To advise on policies for nature conservation, and for protecting and maintaining the ecological balance in Macao;
- To submit legislative proposals, pertinent to protecting the environment and maintaining the ecological balance, to the Chief Executive of the Macao SAR;

¹ Data source: web site of the Environment Council. From the Macao SAR Portal (<http://www.gov.mo>), the organization chart shows the name of Environment Council as “Environmental Protection Committee”.

- To sign cooperation agreements and protocols;
- To organize training and promotional activities for environmental protection and ecological balance;
- To advise on applications for industrial licenses for activities with possible environmental or ecological impact;
- To monitor compliance with the execution of environmental regulations;
- To enhance scientific research into the environmental protection and ecological balance; and
- To issue the annual *Report on the State of the Environment of Macao*.

Apart from the Environment Council, some other government departments also have responsibilities in the execution of environmental policies. The Transport Bureau² is responsible for the inspection of vehicles, monitoring exhaust emission and analysis of ingredient of unleaded gasoline. The Macao Economic Services is responsible for monitoring the import and export of restricted goods, such as trichloroethylene, hydrochlorofluorocarbons (HCFCs), etc. The Meteorological and Geophysical Bureau is responsible for monitoring air pollution, greenhouse gas emission, etc.

Related Rules, Regulations and International Conventions

Macao began to enact laws and regulations on nature conservation more than 20 years ago. These included the establishment of nature reserves and the protection of flora and fauna of special interests. Amongst which, the Environmental Law, enacted in March 1991, sets out general guidelines and basic principals for the formulation of environmental policies.

Rules and regulations in relation to the control of air pollution and greenhouse gas emission are as follow³:

1. The Environmental Law (Lei de Bases do Ambiente, 1991);
2. Regulations for annual compulsory vehicles inspection (Regulamenta a inspeção anual obrigatória dos automóveis ligeiros de passageiros, motociclos e ciclomotores, 1994);
3. Define the characteristics of unleaded gasoline (Define as características da gasolina sem chumbo e restringe, 1994);
4. Inclusion in the Criminal Law clauses in relation to the prevention of pollution (Prevêo crime de Poluição, Código penal article 268, 1995);
5. Control and reduce the use of those substances that would further deplete the

² The Transport Bureau was established in May 2008. Before the establishment, The Civic and Municipal Affairs Bureau was responsible for car inspection and related works.

³ Non-official English translation together with the official Portuguese legislation name and year issued.

ozone layer (Estabelece as medidas de controlo e redução do uso de substâncias que empobrecem a Camada do Ozono, 1995);

6. Restructure the Environment Council (Reestrutura o Conselho do Ambiente Geral, 1998);
7. Define the sulphur content of diesel oil (vehicles) (Define o teor de enxofre no gasóleo para veículos, 2006);
8. The limit of emission of pollutants by newly imported vehicles (Fixação dos limites de emissão de gases poluentes a que devem obedecer os motociclos e ciclomotores novos aquando da sua importação, 2008) .

The People's Republic of China resumed the exercise of sovereignty over Macao from 20 December 1999. According to article 138 of the Basic Law of Macao SAR, the following international agreements and conventions became applicable to Macao:

1. Vienna Convention for the Protection of the Ozone Layer (1985);
2. Montreal Protocol on Substances that Deplete the Ozone Layer (1987);
3. The United Nations Framework Convention on Climate Change (1992);
4. Kyoto Protocol (2008) .

Air Pollution and Greenhouse Gas Emission in Macao

There is not much industrial activities with heavy pollutions in Macao, however, population density (551,900 recorded on 30 June 2008), scarcity of land, narrow streets, busy traffic and regional pollutions affect the air quality of Macao.

The pollutant emission sources include power plant, transportation, industrial and commercial activities, and waste incineration. The atmospheric pollutants include carbon monoxide, oxysulfide, nitrogen oxides, ammonia, non-methane volatile organic compound (NMVOC), respirable suspended particulates with diameters less than 10 µm and lead.

In 2005, there was an increase in all kind of atmospheric pollutant emissions except for nitrogen oxides (24.5% less than 2004). The increase in emissions included carbon monoxide by 7.5%, oxysulfide by 8.9%, ammonia by 8.7%, NMVOC by 10.9% and lead by 11.2%. Both respirable suspended particulates and those with diameters less than 10 µm have obvious increases by 14.3% and 19.5%⁴ respectively. After the outbreak of SARS in 2003, the amount of the above emissions increased every year.

On 19 July 2005, a record high of 39°C marked the highest temperature in Macao

⁴ Data source: 《Report on the State of the Environment of Macao 2006》

since 1901. The change of climate affects all human beings. The greenhouse gas emission in Macao are mainly carbon dioxide, nitrous oxide and methane. The total emission in 2005 increased by 8.3% as compared to that of 2004.

Macao has experienced rapid growth in recent year. This is reflected in the significant growth in population, GDP and number of vehicles. Heavy traffic and the increasing demand of electricity and waste incineration are the major sources of pollution and greenhouse gas emission. In 2005, local electricity was the greatest greenhouse gas emission source (51.7%), the second was solid waste incineration (9.7%) and then, came the road traffic (9.3%). The other sources were industrial, commercial and services industries, household waste, landfills and waste water treatment plant, maritime and aviation transport.

Growth Rates for the Year 2005-2007				
Year	Population	GDP	Vehicle	Consumption of Electricity
2005	4.68%	6.9%	7.99%	13.45%
2006	6.02%	17.0%	6.77%	12.26%
2007	4.81%	27.3%	7.15%	23.13%
End-of-Period Amount	538,100	153,608 Million Patacas	175,845	2,984.3 Million kilowatt-hour

Data source : Statistics and Census Bureau

(1 USD = 8.01 Patacas)

Air pollution and greenhouse effect could result in climate change and sea level rising. As Macao is located at the southeast coast of China, and most of the lands come from sea reclamation, one-third lands in Macao have a height of only two to five feet above sea level. The sea level rising poses significant threats to flat lands and thriving business activities on it. A major rise in relative sea level would result in great economic loss to Macao.

Works of the Government

From 1987, the Meteorological and Geophysical Bureau (SMG) started monitoring air pollution among roadside, high density residential area and some other districts. The SMG summarizes daily air quality and reports to the public together with a forecast for the following day.

In July 2005 the Environment Council launched a study of Macao's fixed sources of air pollution and their distributions. The research targeted industrial establishments

on the Macao peninsula, Taipa and Coloane. With the use of atmospheric model software, the study focused on the pollutants, such as suspended particulates, oxysulfide, nitrous oxide and carbon monoxide, discharged from the chimneys of local industrial establishments, so as to better understand the local fixed sources of pollution. In addition, to understand the indoor air quality of Macao, the Environment Council has, since late 2006, gradually launched an indoor air quality study project targeting public venues such as schools, hotels, car parks and catering places.

New rules implemented in January 2006 prescribe that the sulphur content of light diesel fuel should not exceed 0.005% by weight. (which was 0.05% in the past). The Environment Council collected samples of commercial light diesel for vehicles from all fuel tanks in Macao. The results of analysis indicate that the sulphur content in these samples ranged from values of 0.00264% to 0.00429% by weight in compliance with the new requirement.

One of the important functions of the Environment Council is to increase public awareness and promote environmental education. In 2006, a total of 45,089 person-time have participated in various activities; these included environmental photo exhibition on tour at schools, competition of “Green Community” and Earth Day.

Conclusion

The air quality of Macao is affected by both internal and regional causes. Macao does not have industrial activities with heavy pollutions, however, great economic and population growth, and increased movement of people and goods have resulted in increased demand for electricity and transportation in recent years. As a result, the air quality of Macao became worse.

The main sources of air pollution are the power plant, transportation, solid waste incineration, waste water treatment plant and other industrial and commercial activities. The two main sources, local electricity produces carbon dioxide, nitrogen oxides, ammonia and respirable suspended particulates, etc.; transportation produces non-methane volatile organic compound, carbon monoxide and lead, etc.

The Macao government promotes city greening, supports education in environmental protection, and encourages the use of renewable energy to reduce air pollution and greenhouse gas emission, and regulates exhaust emission by vehicles. There are no specific rules and regulations to monitor industrial and commercial activities for atmospheric pollutant emissions. There are also not enough research

and analysis in specific international conventions to facilitate the formation of efficient mechanism to monitor the execution of such environmental protection activities.

The issues of environmental protection deal with all human beings. The Audit Commission of Macao SAR is concerned about the environmental issues, however, no specific audit work started due to lack of human resources and techniques. The Audit Commission will continue to collect related information and deploy more resources for the work.