Air Quality and Noise Management

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Pollution Control Department

Sources of Air Pollution

- Stationary sources/ Point sources
- Mobile sources/ Line sources
- Area sources
Sources of Air Pollution in Bangkok

Estimation of PM$_{10}$ from Mobile source in 2000
Air Pollution Issue

- Public annoyance or impacting public health
- Levels of the problem are defined by
  - Type of pollutants
  - Concentration of pollutants
  - Exposure time

Why? air pollution must be controlled

- Its impact on human health
  - Acute effect
  - Chronic effect
- Its impact on crops/vegetation
- Its impact on materials/buildings
Sizes of particulate matters

Figure 1. Comparison of PM sizes.

Human Hair
- 70 μm average diameter

PM<2.5 μm
<2.5 μm in diameter

PM10
<10 μm in diameter

90 μm in diameter
Fine Beach Sand

Health Impact

PM 7 - 11 micron
PM 4.7 - 7 micron
PM 3.3 - 4.7 micron
PM < 2.5 micron

nasal passage
mouth
trachea
bronchi
bronchioles
alveoli
lung
diaphragm
Overall Policy

- Control and reduction of emissions from key sources, i.e. On-road vehicles, industry, construction, and field open burning
- Management of area-wise air pollution taking the concept of carrying/assimilating capacity

Overall Policy (continued)

- Enhance capacity of local environmental agency in monitoring environmental quality and status of emission sources
- Development and update the emission database in critical area
- ส่งเสริมการใช้เทคโนโลยีสะอาดและเชื้อเพลิงสะอาด
Overall Policy (continued)

- Enhance annual vehicle inspection programme
- Enhance public participation in air pollution management
- Implement measures for controlling open burning and developing the monitoring and early warning system for air pollution and haze forecast

Focused area

Urban
- Bangkok,
- Samutprakarn,
- Nonthaburi,
- Khonkaen,
- Korat, Phuket,
- Songkhla, and
- Chiang Mai

Industrial
- Samutprakarn,
- Chonburi, Rayong,
- Ayutthaya, Lumphun,
- Samutsakorn,
- Chachernsao,
- Pathumthani
- Rock mining and cement industry in Saraburi, Ratchaburi, Kanchanaburi, Chonburi, Suphanburi

Agricultural
- Chiang Mai,
- Lampang,
- Ayutthaya, Lopburi,
- Chainat, Bhijit,
- Phitsanuloke,
- Kampangpetch,
- Nakornsawan,
- Khonkaen, Korat, Srakaew,
- Suphanburi, and
- Kanchanaburi
Vehicles

“High Quality New vehicles,
proper maintenance, clean fuel”

Measures for prevention and mitigation of Automotive Emission

- Preventive measure
- Control measure
- Other additional measures

ควันพิษจากรถโดยสารร่วมบริการ
Preventive Measures

- Stringent emission standards for new vehicles
- Emission standards for in-use vehicles
- Specify improvement of fuel quality

Control Measures

- Improvement of mass transportation
- Inspection and Fine
- Inspection service to co-service private buses and Civil Service vehicles
- New buses engine must comply to EURO 2 standard
- Promotion of low-pollution vehicles
- Annual vehicle inspection prior to renewal registration
**Other additional measures**

1. **Alternative fuel**
   - Dual and Bi- Fuel System
   - Compressed Natural Gas (CNG) for Buses and Taxi
   - Demonstration of Electric vehicles
   - Liquid Petroleum Gas (LPG) for Tuk-Tuk

2. **Inspection and Maintenance of public buses**

3. **Emission Clinic Programme**

4. **Public relation and promotion**
Industry

“Legal Measures, Clean Technology, Area-wise Pollution Management”

Industrial Air Pollution Management

- Prevention
- Command/control and monitoring
- Other measures
Prevention

- Selection of Industrial Location
- Specifying Particular Industrial Area
- Report of Environmental Impact Assessment (EIA)
- Promote Clean technology (Pollution Prevention, P2)
- Control Fuel Quality / Clean Fuel
- Energy Conservation or Energy Efficiency

Command/Control and Monitoring

- Emission Standards from Industrial Stacks
- Control Standards from Dispersive Emission Sources
- Installation of Emission Reduction/Control
- Emission stack sampling and production monitor
- Installation of Continuous Emission Monitoring System
- Investigation of Public Appealing Cases
Other measures

- Public relation and participation of stake holders
- Providing information on air quality through media
- Social measures e.g. awards / certificates
- Economic measures e.g. emission charge, emission fee, emission tax

Open Burning Control Measures

“Proper Waste Management, No Roadside Burning, No-burning agricultural technology, No forest burning / fire”
Policy for Open Burning Control

ASEAN Agreement on Transboundary Haze

National Master Plan on Open Burning Control

Action Plan following the National Master Plan (2004 - 2008)

Implementation Programme following the National Master Plan on Open Burning Control

Strategy I.
Ratified ASEAN Agreement on Transboundary Haze

Strategies

• Determine responsible agencies for implementation following the ASEAN agreement
• Constructing haze monitoring system
• Control ignition factors on ground and forest fire
• Preparation of the joint implementation with other ASEAN countries
• Issue the National Emergency Plan
• Support and collaboration on Scientific Research and Technology on the related issues
Strategy II.
Management of Agricultural Residue

Strategies

- Promotion and Support Agricultural Technology for reduction of open burning
- Enable applications of agricultural residue to replace burning practice
- Support of research on application of agricultural residue
- Publish Guideline on the Management of Agricultural Residue Application

Strategy III.
Community Waste Management

Strategies

- Improve Waste Management System into Full Cycle
- Promote Suitable Technologies for Waste Management and 3R (Reduce, Reuse, and Recycle)
- Improve Law and Regulation
- Promote Public Participation
- Determine Action Plan in the Local Administrative Levels
Strategy IV: Forest Fire Management

Strategies:
- Prevention of Forest Fire
- Detection of Forest Fire
- Extinguish of Forest Fire
- Restoration of Forest after Fire

Strategy V: Promotion of Recyclable Energy

Strategies:
- Promotion of Electricity Generation using Recyclable Energy
- Use Recyclable Energy as Fuel
- Economical Measures
- Promote Participation “Trilateral”
Strategy VI.
Promotion and Public Relation

Strategies

• Public Relation Mechanism for raising awareness of all stakeholders to the significance of open burning control and participation in pollution reduction
• Issue Guidelines and Rules for Controlling Open Burning

Strategy VII.
Law Enforcement

Strategies

• Amendment of Law and Regulation including the Related Governmental Practices for Enabling of Open Burning Control

<table>
<thead>
<tr>
<th>Regulations for Local Authorities</th>
<th>Regulations for Central Authorities</th>
<th>General Law</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Health Act B.E. 2535</td>
<td>Forestry Act B.E. 2484 มหาวิทยาลัย 54</td>
<td>Criminal Law มหาวิทยาลัย 220</td>
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<td>Decree 26 Local authorities can issue</td>
<td>Forest Sanctuary Act B.E. 2057 มหาวิทยาลัย 14</td>
<td>Commercial Law มหาวิทยาลัย 420</td>
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<td>ในกรณีที่มีการตัดเห่าหรือผู้ครอบครองอาคาร</td>
<td>National Park Act B.E. 2504 มหาวิทยาลัย 16</td>
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</table>
ข้อปฏิบัตินเบื้องต้นในภาวะมลพิษหมอกควัน

• หลีกเลี่ยงการอยู่ภายในอาคารเป็นเวลานาน และลดการออกกำลังกาย
• ปิดประตูหน้าต่างไม่ให้ฝุ่นละอองเข้าบ้าน
• เด็ก ผู้ป่วยโรคทางเดินหายใจ หรือผู้สูงอายุ ควรอยู่ในบ้านหรือ
  ไม้อาคาร และหลีกเลี่ยงการเดินทางในสภาพอากาศที่มีฝุ่นละอองสูง
• หากต้องอยู่ในสภาพที่มีฝุ่นละอองหนาทึบ ให้ใช้ผ้าชุบน้ำปิดจมูก หรือ
  สวมหน้ากากกรองฝุ่น
• งดการรองน้ำฝนไว้ใช้อุปโภคบริโภคชั่วคราว
• หากมีอาการผิดปกติของระบบทางเดินหายใจ ควรรีบไปพบแพทย์
• ติดตามรับฟังข่าวสารจากทางราชการ

**Ambient Air Quality Monitoring Network**

<table>
<thead>
<tr>
<th>Region</th>
<th>Air Quality Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>6</td>
</tr>
<tr>
<td>N-Eastern</td>
<td>2</td>
</tr>
<tr>
<td>Central</td>
<td>32</td>
</tr>
<tr>
<td>East</td>
<td>8</td>
</tr>
<tr>
<td>South</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>53</strong></td>
</tr>
</tbody>
</table>
1. Ambient air quality monitoring station

- 53 Automated ambient air quality monitoring stations

- Pollutants are:
  - CO
  - SO₂, NO, NO₂, NOₓ
  - O₃
  - THC, CH₄, NMHC
  - PM₁₀
  - PM₂.₅

Instruments

PM₁₀ Instrument
2. Meteorological monitoring network

<table>
<thead>
<tr>
<th>Region</th>
<th>Meteorological 100-meter masts</th>
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<tbody>
<tr>
<td>North (Chiang mai)</td>
<td>1</td>
</tr>
<tr>
<td>Northeast (Khon kaen)</td>
<td>1</td>
</tr>
<tr>
<td>Central (Bangkok)</td>
<td>1</td>
</tr>
<tr>
<td>East (Ra yong)</td>
<td>1</td>
</tr>
<tr>
<td>South (Song khla)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>

2.1) 100-meter meteorological masts

2.2) Meteorological masts at Stations – 10 or 30 m.
### Parameters Measured at Different Heights

<table>
<thead>
<tr>
<th>Height Above Ground (meters)</th>
<th>Parameters Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Solar radiation, Net radiation, Barometric pressure, and Precipitation</td>
</tr>
<tr>
<td>10</td>
<td>Wind speed, 3-dimensional wind direction, Temperature, and Relative humidity</td>
</tr>
<tr>
<td>50</td>
<td>Wind speed, 3-dimensional wind direction, Temperature, and Relative humidity</td>
</tr>
<tr>
<td>100</td>
<td>Wind speed, 3-dimensional wind direction, Temperature, and Relative humidity</td>
</tr>
</tbody>
</table>

- Parameters: (10 or 30 meters)
  - Wind (speed & direction)
  - Temperature
  - Radiation (solar & net)
  - Humidity, Precipitation, Pressure

Wind speed & wind direction
### Spatial Distribution of Air Quality Monitoring Stations & 100-meter Met. Masts

<table>
<thead>
<tr>
<th>Region</th>
<th>Province</th>
<th>No. of Stations</th>
<th>No. of 100-m. masts</th>
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<tbody>
<tr>
<td>Central Region</td>
<td>Bangkok</td>
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<td>Samut Prakarn</td>
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<tr>
<td></td>
<td>Pathum Thani</td>
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<td></td>
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<tr>
<td></td>
<td>Nontha Buri</td>
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<td></td>
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<tr>
<td></td>
<td>Ayut Thaya</td>
<td>1</td>
<td></td>
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<tr>
<td></td>
<td>Sara Buri</td>
<td>2</td>
<td></td>
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<tr>
<td></td>
<td>Ratcha Buri</td>
<td>1</td>
<td></td>
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<tr>
<td></td>
<td>Samut Sakhorn</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Nakhon Sawan</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Northern Region</td>
<td>Chiang Mai</td>
<td>2</td>
<td>1</td>
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<td></td>
<td>Lam Pung</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>North Eastern Region</td>
<td>Khon Kaen</td>
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<td>1</td>
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<tr>
<td></td>
<td>Nakbhorn</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ratchasima</td>
<td></td>
<td></td>
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<tr>
<td>Eastern Region</td>
<td>Chon Buri</td>
<td>3</td>
<td>1</td>
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<tr>
<td></td>
<td>Ra Yong</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cha Choeng Sao</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Southern Region</td>
<td>Surat Thani</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Phu Ket</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Song Khla</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ya La</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nara Thiwat</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>53</td>
<td>6</td>
</tr>
</tbody>
</table>
REMOTE STATION

Diagram of Ambient Air Quality Monitoring Station and Data Transmission System

PCD central processing computer for data storage and analysis
7 mobile ambient air quality monitoring units for air pollution episodes and other special air quality pollution studies

3. Monitoring of PM$_{2.5}$ Microns

- PCD is in the process of establishing ambient air quality standard for PM$_{2.5}$
- Background information is being collected for the consideration of standard level
4. Bangkok’s Air Quality Monitoring Program

4.1 General Ambient Air Quality Monitoring

- Automated ambient air quality monitoring stations
  - Consist of 10 stations
  - Air pollutant measured:
    - CO, TSP, PM$_{10}$, NO$_x$, O$_3$, SO$_2$, HC, Pb

- 10-meter meteorological masts measuring:
  - Wind Speed,
  - Wind Direction,
  - Temperature,
  - Relative Humidity,
  - Solar Radiation,
  - Net Radiation,
  - Rain, Pressure
4.2 Curbside Street-Level Ambient Air Quality Mon

- Long-Term Continuous Curbside Ambient Air Quality Monitoring
  - Automated ambient air quality monitoring stations (7 stations): CO, TSP, PM$_{10}$, PM$_{2.5}$, NO$_x$, O$_3$, SO$_2$, HC, Pb
  - 10-meter meteorological masts measuring:
    - WS, WD, TEMP, SOLAR RAD, NET RAD, Rain, RH, Pressure

- Short-Term Temporary Curbside Ambient Air Quality Monitoring
  - Air pollutant measured: CO, TSP, PM$_{10}$, Pb
  - Approximated 15 most congested streets in BKK
  - Sampling period: ~2 week at each street
  - Data are collected manually

**Short-Term Temporary Curbside Ambient Air Quality Monitoring In Bangkok**

High Volume Air Samplers for TSP & PM$_{10}$
5. Display Boards

- Public information about air quality
- To instantaneously display air quality data to the public
- 9 display boards
  - Bangkok : 4
  - Chiang Mai : 1
  - Sara Buri : 1
  - Ya La : 1
  - Nara Thiwat : 1
  - Samut Phrakran : 1

Air Quality Index (AQI)
Air Quality Info through Media

- Bangkok Post
- Display Boards at 3 BMR sites (Intersections: Taksin, Wittayu, Lamsalee)
- BTS (skytrain) stations
- Public Relation Department Radio

Bangkok Daily AQI

Public Relation
National Ambient Air Quality Standards 1995

<table>
<thead>
<tr>
<th>Pollutants</th>
<th>Standards</th>
<th>Measurement Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-hr</td>
<td>8-hr</td>
</tr>
<tr>
<td>CO (ppm)</td>
<td>30</td>
<td>9</td>
</tr>
<tr>
<td>NO₂ (ppm)</td>
<td>0.17</td>
<td>-</td>
</tr>
<tr>
<td>SO₂ (ppm)</td>
<td>0.3</td>
<td>0.12</td>
</tr>
<tr>
<td>TSP (mg/m³)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PM₁₀ (mg/m³)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>O₃ (ppm)</td>
<td>0.1</td>
<td>0.07 (2007)</td>
</tr>
<tr>
<td>Pb (mg/m³)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Air Pollution Situation

- Most of major air pollutants (NO₂, SO₂, CO, Pb) are now in compliance with Nation Ambient Air Quality Standards
- Most serious air pollutants are particulate matter and ozone
- Major sources are automobiles, industries, and open-burning
### Ambient Air Quality BKK  2007

<table>
<thead>
<tr>
<th>Pollutants</th>
<th>range</th>
<th>95 Percentile</th>
<th>Std</th>
<th>exceed Std/monitoring time (%)</th>
<th>Annual avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSP avg 24 hr (mg/m³)</td>
<td>0.02-0.43</td>
<td>0.18</td>
<td>0.33</td>
<td>2/473 (0.42)</td>
<td>0.09</td>
</tr>
<tr>
<td>PM₁₀ avg 24 hr (ug/m³)</td>
<td>10.8-188.9</td>
<td>90.6</td>
<td>120</td>
<td>22/1,957 (1.1)</td>
<td>46.6</td>
</tr>
<tr>
<td>Pb avg 1 month (ug/m³)</td>
<td>0.01-0.28</td>
<td>0.17</td>
<td>1.5</td>
<td>0/119 (0.0)</td>
<td>0.07</td>
</tr>
<tr>
<td>CO avg 1hr (ppm)</td>
<td>0.0-6.4</td>
<td>1.7</td>
<td>30</td>
<td>0/79,818 (0.0)</td>
<td>0.7</td>
</tr>
<tr>
<td>CO avg 8 hr (ppm)</td>
<td>0.0-4.9</td>
<td>1.6</td>
<td>9</td>
<td>0/82,712 (0.0)</td>
<td>0.7</td>
</tr>
<tr>
<td>O₃ avg 1 hr (ppb)</td>
<td>0.0-186.0</td>
<td>56.0</td>
<td>100</td>
<td>133/58,411 (0.2)</td>
<td>17.2</td>
</tr>
<tr>
<td>SO₂ avg 1 hr (ppb)</td>
<td>0.0-43.0</td>
<td>10.0</td>
<td>300</td>
<td>0/75,757 (0)</td>
<td>4.1</td>
</tr>
<tr>
<td>SO₂ avg 24 hr (ppb)</td>
<td>0.0-16.2</td>
<td>8.7</td>
<td>120</td>
<td>0/2,995 (0)</td>
<td>4.1</td>
</tr>
<tr>
<td>NO₂ avg 1 hr (ppb)</td>
<td>0.0-148.0</td>
<td>52.0</td>
<td>170</td>
<td>0/77,014 (0)</td>
<td>21.7</td>
</tr>
</tbody>
</table>

### Ambient Air Quality BKK  Road Side 2007

<table>
<thead>
<tr>
<th>Pollutants</th>
<th>range</th>
<th>95 Percentile</th>
<th>Std</th>
<th>exceed Std/monitoring time (%)</th>
<th>Annual avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSP avg 24 hr (mg/m³)</td>
<td>0.03-0.76</td>
<td>0.31</td>
<td>0.33</td>
<td>26/619 (4.2)</td>
<td>0.15</td>
</tr>
<tr>
<td>PM₁₀ avg 24 hr (ug/m³)</td>
<td>9.8-242.7</td>
<td>118.1</td>
<td>120</td>
<td>92/1,970 (4.7)</td>
<td>60.9</td>
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<tr>
<td>Pb avg 1 month (ug/m³)</td>
<td>0.02-0.19</td>
<td>0.13</td>
<td>1.5</td>
<td>0/104 (0.0)</td>
<td>0.07</td>
</tr>
<tr>
<td>CO avg 1hr (ppm)</td>
<td>0.0-16.3</td>
<td>3.4</td>
<td>30</td>
<td>0/62,091 (0.0)</td>
<td>1.4</td>
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<tr>
<td>CO avg 8 hr (ppm)</td>
<td>0.0-9.4</td>
<td>3.0</td>
<td>9</td>
<td>0/62,364 (0.01)</td>
<td>1.4</td>
</tr>
<tr>
<td>O₃ avg 1 hr (ppb)</td>
<td>0.0-102.0</td>
<td>39.0</td>
<td>100</td>
<td>1/24,561 (0.004)</td>
<td>11.6</td>
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<tr>
<td>SO₂ avg 1 hr (ppb)</td>
<td>0.0-42.0</td>
<td>12.0</td>
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<td>0/24,359 (0.0)</td>
<td>5.3</td>
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<tr>
<td>SO₂ avg 24 hr (ppb)</td>
<td>0.0-19.0</td>
<td>9.6</td>
<td>120</td>
<td>0/1,014 (0.0)</td>
<td>5.3</td>
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<tr>
<td>NO₂ avg 1 hr (ppb)</td>
<td>0.0-150.0</td>
<td>68.0</td>
<td>170</td>
<td>0/24,586 (0.0)</td>
<td>31.4</td>
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</table>
**NO₂ annual average BKK 1997 - 2007**

<table>
<thead>
<tr>
<th>Year</th>
<th>NO₂ annual average (ppb)</th>
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<tr>
<td>1997</td>
<td>35.0</td>
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<tr>
<td>1999</td>
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<td>2001</td>
<td>25.0</td>
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<td>2003</td>
<td>20.0</td>
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<td>2005</td>
<td>15.0</td>
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<tr>
<td>2007</td>
<td>10.0</td>
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</tbody>
</table>

- **Road side**
- **General area**

**SO₂ annual average BKK 1997 - 2007**

<table>
<thead>
<tr>
<th>Year</th>
<th>SO₂ annual average (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>6.0</td>
</tr>
<tr>
<td>1999</td>
<td>8.0</td>
</tr>
<tr>
<td>2001</td>
<td>10.0</td>
</tr>
<tr>
<td>2003</td>
<td>12.0</td>
</tr>
<tr>
<td>2005</td>
<td>14.0</td>
</tr>
<tr>
<td>2007</td>
<td>16.0</td>
</tr>
</tbody>
</table>

- **Road side**
- **General area**
O_{3} annual average BKK 1996 - 2007

- Road side
- General area

...ร่วมมือ ร่วมใจ คืนฟ้าให้สดใส ไร้เสียงดัง ...

[Image: www.pcd.go.th / โทร 0 2298 2397]