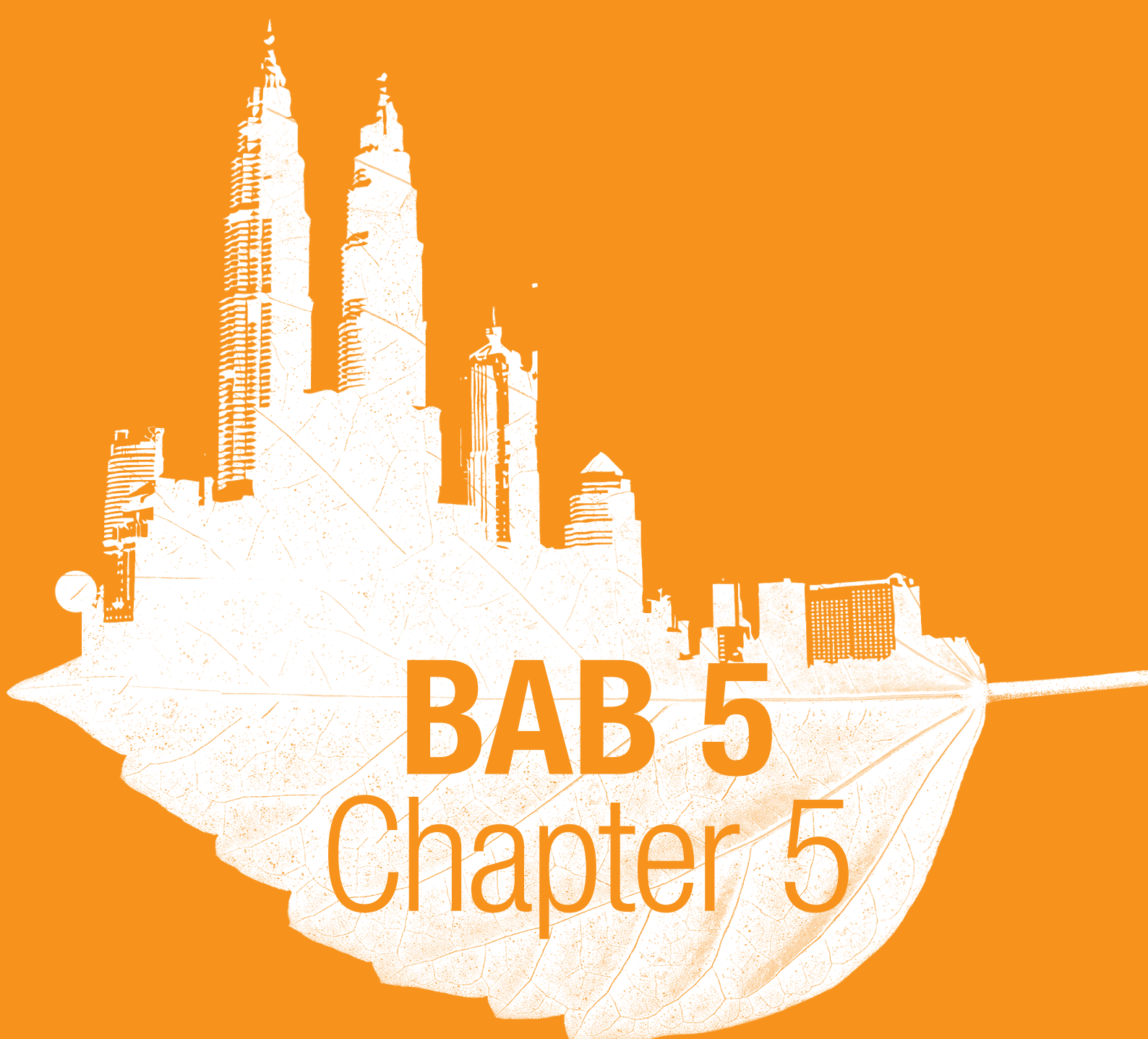




BAB 5

Chapter 5

Inventori Punca
Pencemaran
Pollution Sources Inventory

BAB 5 | CHAPTER 5

INVENTORI PUNCA PENCEMARAN

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PENGIRAAN BEBAN PENCEMARAN

Pendahuluan

Beban pencemaran air adalah kepekatan bahan cemar yang dibawa oleh jasad air pada sesuatu masa yang diberikan. Secara matematik, beban pada dasarnya adalah hasil daripada pelepasan air dan kepekatan bahan di dalam air.

Beban pencemaran air adalah penting untuk tujuan mengatur strategi dan merancang tindakan pencegahan dan mengawal pencemaran. Pelaksanaan kawalan beban pencemaran air adalah usaha untuk meningkatkan kualiti air sungai demi mengekalkan pelbagai kegunaan berfaedah sungai seperti sumber bekalan air, rekreasi, ternak air (akuakultur), pertanian serta menampung keperluan sistem ekologi.

BEBAN PENCEMARAN AIR

Pada tahun 2016, anggaran pengiraan beban pencemaran ditumpukan ke atas lima (5) jenis punca pencemaran air iaitu industri pembuatan, industri berasaskan pertanian, loji rawatan kumbahan, ternakan babi dan pasar basah.

Sumber data industri pembuatan dan industri berasaskan pertanian diperolehi daripada JAS negeri manakala bagi loji rawatan kumbahan adalah daripada Indah Water Konsortium Sendirian Berhad. Data-data berkaitan aktiviti ternakan babi diperolehi daripada Jabatan Perkhidmatan Veterinar dan Pihak Berkuasa Tempatan membekalkan data bilangan pasar basah.

Pengiraan beban pencemaran di tumpukan kepada tiga (3) parameter utama yang memberikan kesan

POLLUTION LOAD CALCULATION

Introduction

Water pollution load are the amount of polluting material that a water body is actually carrying at a given time. Mathematically, load is essentially the product of water discharge and the concentration of a substance in the water.

The pollution loads are useful in strategizing and planning the course of action for the prevention and control of pollution, so as to maintain the beneficial use of rivers as a source of water supply, recreation, aquaculture, agriculture as well as meeting the needs of ecological system.

WATER POLLUTION LOAD

In the year of 2016, the estimation of pollution loads are focused on five (5) types of water pollution sources such as manufacturing industries, agricultural industries, sewage treatment plant, piggery and wet market.

State DOE provides data on manufacturing industries and agricultural industries while sewage treatment plant were obtained from Indah Water Consortium Sendirian Berhad. Department of Veterinary Services provide piggery data and data on wet market were acquired from Local Authority.

Assessment on pollution load were focused on three (3) main parameter that shows high impact to the water

ketara kepada kualiti air sungai iaitu keperluan oksigen biokimia (BOD), pepejal terampai (SS) dan amoniakal nitrogen (AN).

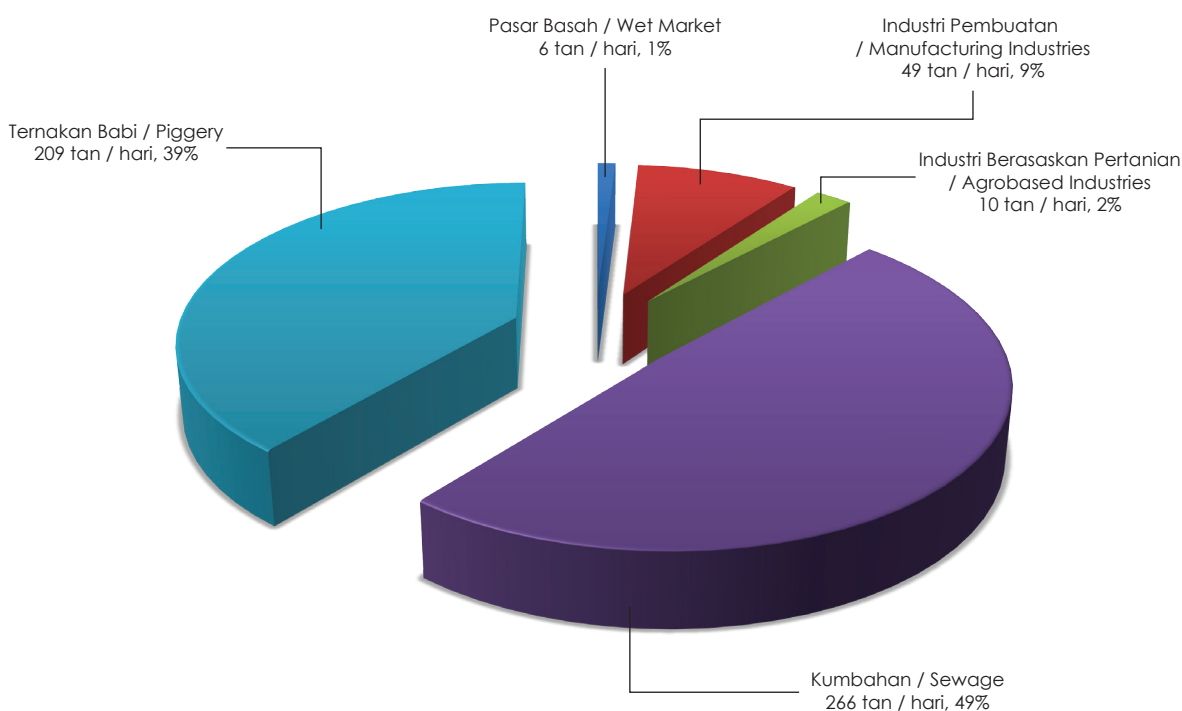
Keperluan Oksigen Biokimia

Pada tahun 2016, anggaran jumlah beban pencemaran BOD adalah sebanyak 540 tan/ hari. Pelepasan dari loji kumbahan adalah penghasil beban pencemaran BOD tertinggi iaitu sebanyak 266 tan/ hari (49%), diikuti aktiviti ternakan babi 209 tan/ hari (39%), industri pembuatan 49 tan/ hari (9%), industri berasaskan pertanian 10 tan/ hari (2%) dan pasar basah 6 tan/ hari (1%) ditunjukkan seperti dalam **Rajah 5.1**.

body namely biochemical oxygen demand (BOD), Suspended Solids (SS) and Ammoniacal Nitrogen (AN).

Biochemical Oxygen Demand

In year 2016, it is estimated that a total of 540 tonnes/ day pollution load for BOD were generated. Sewage remained the largest BOD loads generator with a total load of 266 tonnes/ day (49%), followed by piggery which precipitating 209 tonnes/ day (39%), while manufacturing industries contributed 49 tonnes/ day (9%), agro-based industries 10 tonnes/ day (2%) and wet markets 6 tonnes/ day (1%), as shown in **Figure 5.1**.



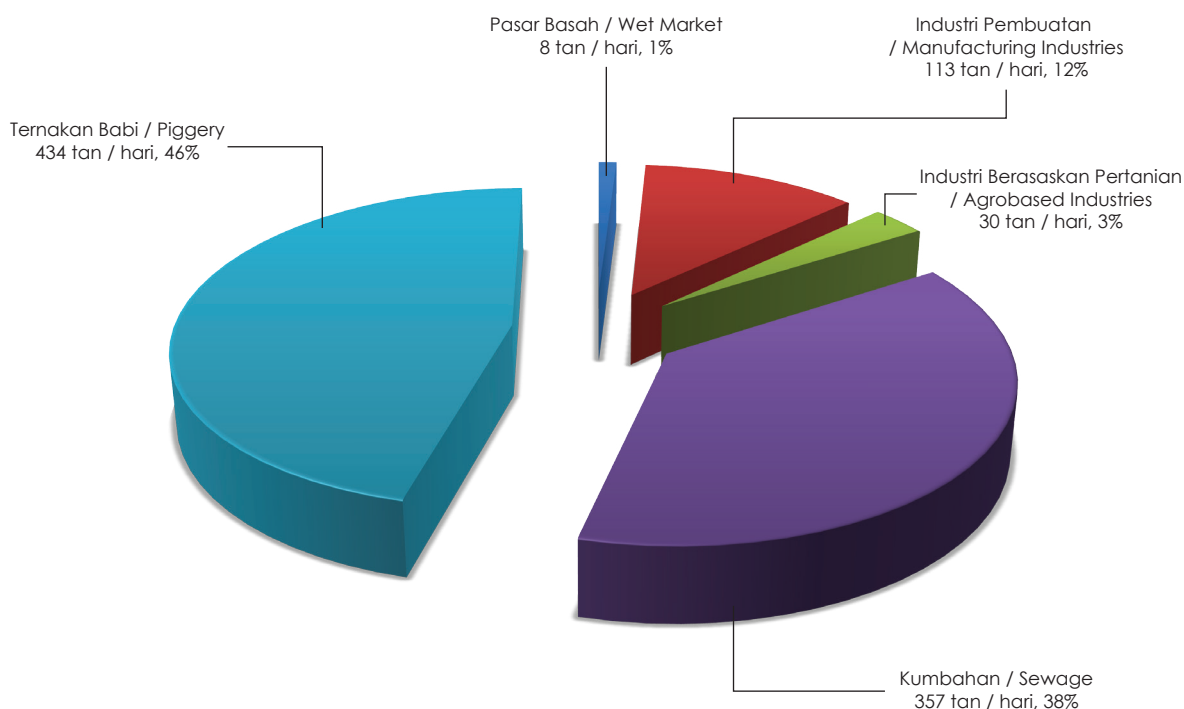
Rajah 5.1: Malaysia : Anggaran Beban BOD Mengikut Punca Pencemaran Air, 2016
Figure 5.1 Malaysia : Estimation of BOD Load by Sources of Water Pollution, 2016

Beban Pepejal Terampai

Pada tahun 2016, anggaran penghasilan beban pencemaran bagi SS adalah sebanyak 942 tan/ hari, di mana aktiviti ternakan babi kekal sebagai penghasil beban pepejal terampai utama dengan jumlah 434 tan/ hari (46%), diikuti pelepasan daripada kumbahan sebanyak 357 tan/ hari (38%), industri pembuatan 113 tan/ hari (12%), industri berasaskan pertanian 30 tan/ hari (3%), dan pasar basah 8 tan/ hari (1%), seperti ditunjukkan dalam **Rajah 5.2**

Suspended Solids Load

In year 2016, estimation of summing-up the SS loads gave in a totalled of 942 tonnes/ day in which piggery remain largest contributor with a total load of 434 tonnes/ day (46%), followed by sewage 357 tonnes/ day (38%), manufacturing industries 113 tonnes/ day (12%), agro-based industries 30 tonnes/ day (3%) and wet market 8 tonnes/ day (1%), as shown in **Figure 5.2**



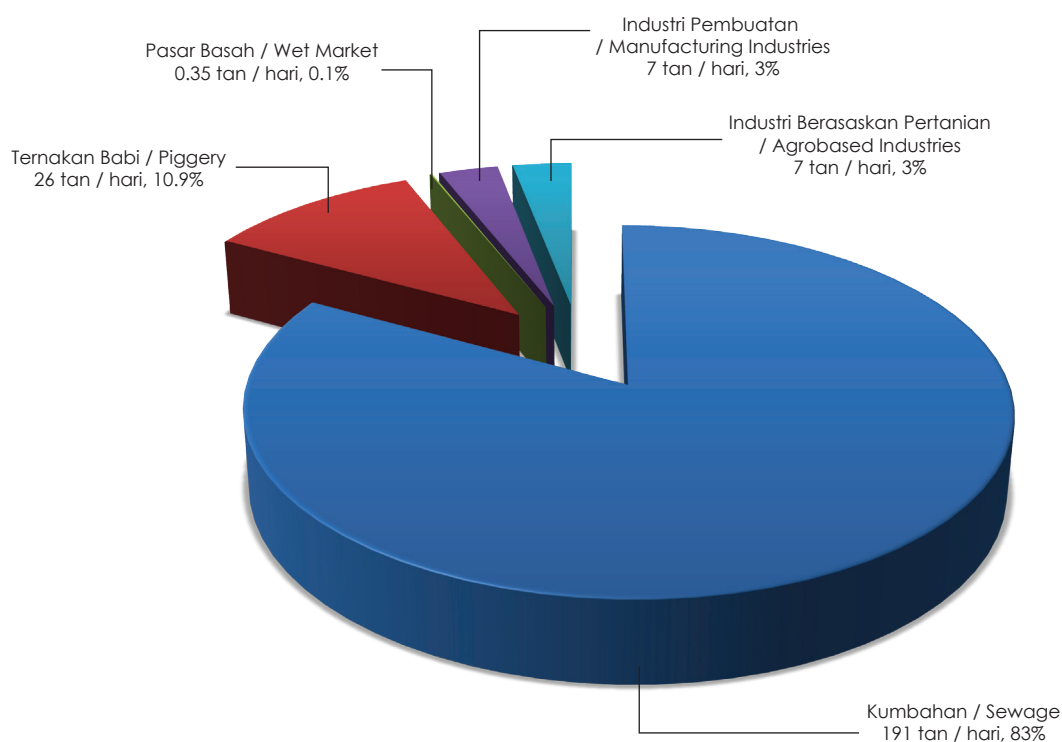
Rajah 5.2 Malaysia : Anggaran Beban SS Mengikut Punca Pencemaran Air, 2016
Figure 5.2 Malaysia : Estimation of SS Load by Sources of Water Pollution, 2016

Beban Ammoniakal Nitrogen

Pada tahun 2016, anggaran beban pencemar AN sebanyak 231.35 tan/ hari di mana pelepasan kumbahan adalah penghasil terbesar beban AN dengan jumlah sebanyak 191 tan/ hari (83%), diikuti aktiviti dari ternakan babi iaitu 26 tan/ hari, industri pembuatan dan industri berasaskan pertanian masing mencatat jumlah sebanyak 7 tan/ hari (3%), dan pasar basah 0.35 tan/ hari (0.1%), ditunjukkan seperti dalam **Rajah 5.3**.

Ammoniacal Nitrogen Load

In year 2016, estimation of assessment on AN loads resulted a totalled of 231.35 tonnes/ day. Analysis showed sewage the largest AN loads with 191 tonnes/ day (83%), followed by piggery activities 26 tonnes/ day, manufacturing industries and agro-based industries both generating 7 tonnes/ day (3%), and wet market 0.35 tonnes/ day (0.1%), as shown in **Figure 5.3**



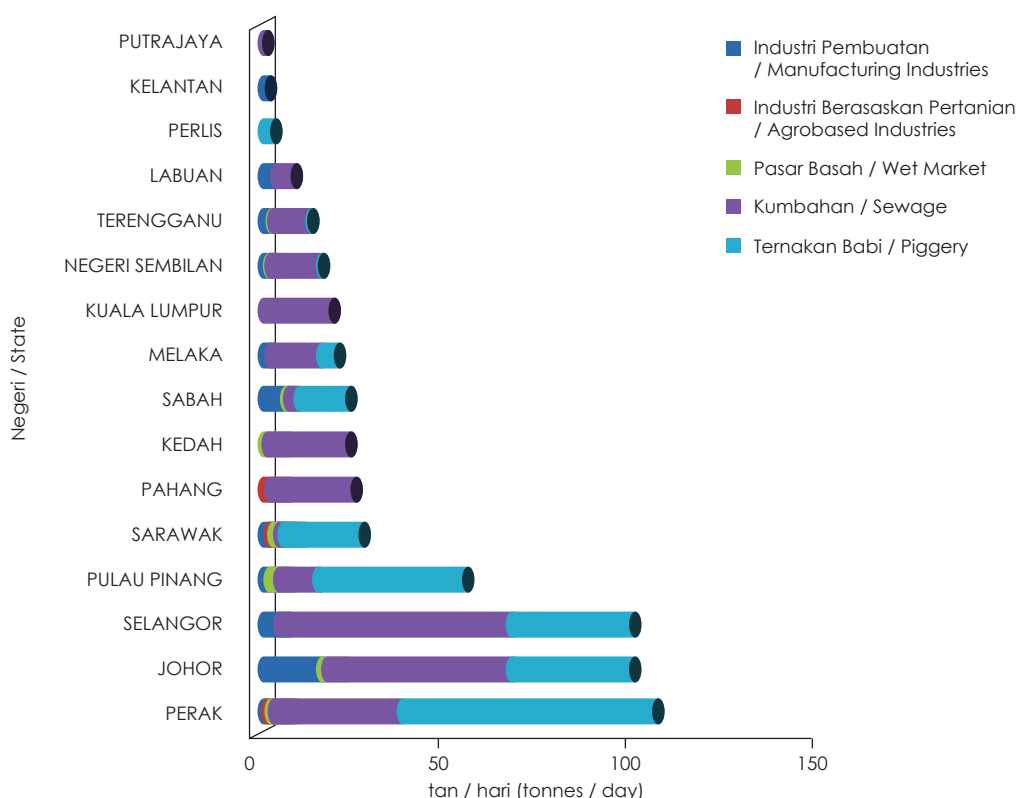
Rajah 5.3 Malaysia : Anggaran Beban AN Mengikut Punca Pencemaran Air, 2016
Figure 5.3 Malaysia : Estimation of AN Load by Sources of Water Pollution, 2016

Beban Pencemaran Keperluan Oksigen Biokimia (BOD) Mengikut Negeri

Anggaran pengiraan beban BOD di negeri Perak adalah tertinggi iaitu sebanyak 106 tan/ hari, diikuti negeri Johor 100 tan/ hari, negeri Selangor 99 tan/ hari, Pulau Pinang 54 tan/ hari dan negeri Sarawak menjana sebanyak 27 tan/ hari. Beban BOD untuk sebelas (11) negeri termasuk Wilayah Persekutuan Labuan dan Putrajaya adalah kurang dari 24 tan/ hari. Senarai beban pencemar BOD mengikut negeri ditunjukkan seperti di **Rajah 5.4**.

Biochemical Oxygen Demand Load (BOD) by State

Estimation of BOD loads generated in the state of Perak recorded the highest value with 106 tonnes/ day, followed by state of Johore 100 tonnes/ day, state of Selangor 99 tonnes/ day, state of Penang 54 tonnes/ day and state of Sarawak was generating 27 tonnes/ day. Other eleven (11) states including federal Territory of Labuan and Putrajaya generated less than 24 tonnes/ day, as shown in **Figure 5.4**.



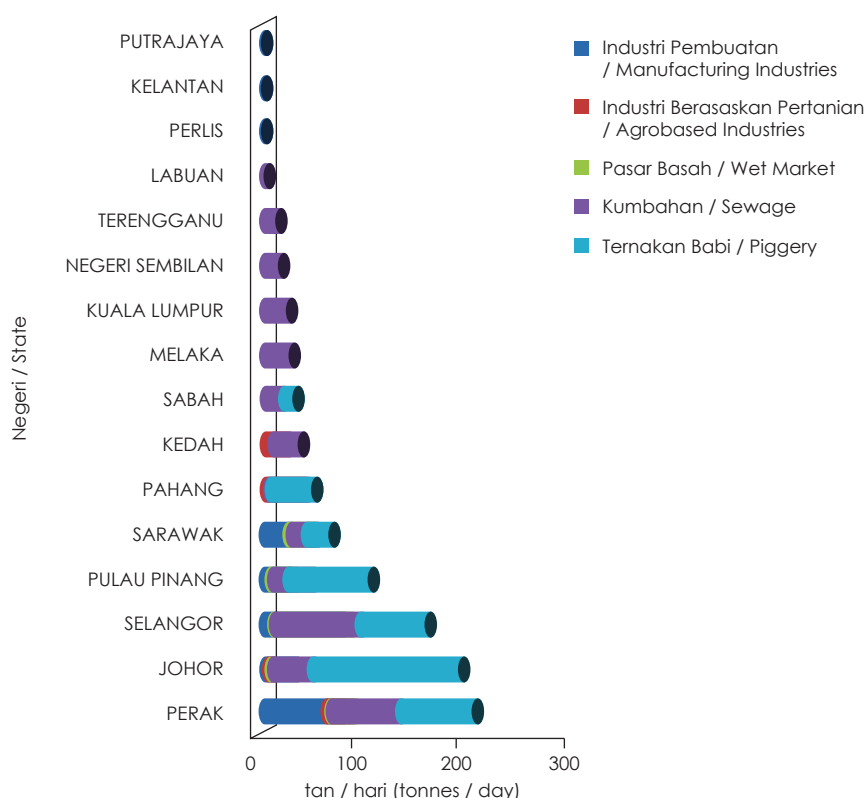
Rajah 5.4 Malaysia : Taburan Anggaran Beban BOD dan Punca Pencemaran Air Mengikut Negeri, 2016
Figure 5.4 Malaysia : Dispersions of BOD Load Estimation and Sources of Water Pollution by States, 2016

Beban Pencemaran Pepejal Terampai Mengikut Negeri

Anggaran penjanaan beban pepejal terampai di negeri Johor di dapati tertinggi dengan jumlah 202 tan/ hari, diikuti negeri Perak 189 tan/ hari, negeri Selangor 156 tan/ hari, Pulau Pinang 106 tan/ hari dan Sabah 62 tan/ hari. Lain-lain negeri didapati menghasilkan kurang daripada 51 tan/ hari ditunjukkan di dalam **Rajah 5.5**.

Suspended Solid Load by State

Estimation of suspended solids loads generated in the state of Johor recorded the highest value with 202 tonnes/ day, followed by state of Perak 189 tonnes/ day, state of Selangor 156 tonnes/ day, state of Penang 106 tonnes/ day and Sabah 62 tonnes/ day. Other states generated less than 51 tonnes/ day, as shown in **Figure 5.5**



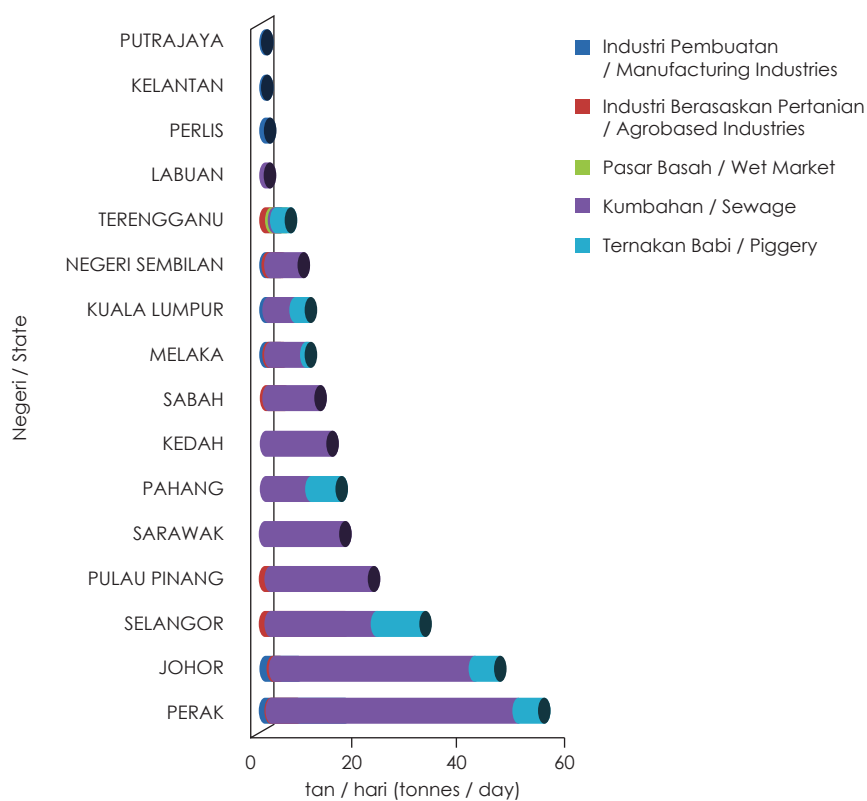
Rajah 5.5 Malaysia : Taburan Anggaran Beban SS dan Punca Pencemaran Air Mengikut Negeri, 2016
Figure 5.5 Malaysia : Dispersions of SS Load Assessment and Sources of Water Pollution by States, 2016

Beban Pencemaran Ammoniakal Nitrogen Mengikut Negeri

Anggaran pengiraan beban AN di negeri Selangor adalah tertinggi dengan jumlah 52 tan/ hari, diikuti negeri Johor 44 tan/ hari, negeri Perak 30 tan/ hari manakala negeri Pahang dan Wilayah Persekutuan Kuala Lumpur masing-masing mencatat jumlah beban sebanyak 16 tan/ hari. Lain lain negeri didapati menyumbangkan kurang dari 15 tan/ hari, ditunjukkan sepertimana dalam **Rajah 5.6**.

Ammoniacal Nitrogen Load by State

52 tonnes/ day of ammoniacal nitrogen (AN) loads was estimate generated by state of Selangor, followed by states of Johor 44 tonnes/ day, state of Perak 30 tonnes/ day while state of Pahang and federal Territory of Kuala Lumpur both generated 16 tonnes/ day. Other states showed to generate less than 15 tonnes/ day, as shown in **Figure 5.6**.



Rajah 5.6 Malaysia : Taburan Anggaran Beban AN dan Punca Pencemaran Air Mengikut Negeri, 2016
Figure 5.6 Malaysia : Dispersions of AN Load Assessment and Sources of Water Pollution by States, 2016

PUNCA- PUNCA PENCEMARAN UDARA

Peningkatan punca industri dan bilangan kenderaan bermotor boleh menyebabkan pencemaran udara yang teruk jika pelepasan pencemar termasuk pelepasan asap daripada kedua-dua aktiviti ini tidak dikawal dengan berkesan.

Sehingga bulan Disember 2016, jumlah punca industri yang tertakluk di bawah Peraturan-Peraturan Kualiti Alam Sekeliling (Udara Bersih) 2014 adalah sebanyak 13,878. Pecahan punca industri berdasarkan negeri adalah seperti **Rajah 5.7**. Bilangan punca pencemar yang tertinggi adalah di negeri Selangor (2,961:21%) diikuti negeri Johor (2,350:17%) dan negeri Sarawak (1,534:11%).

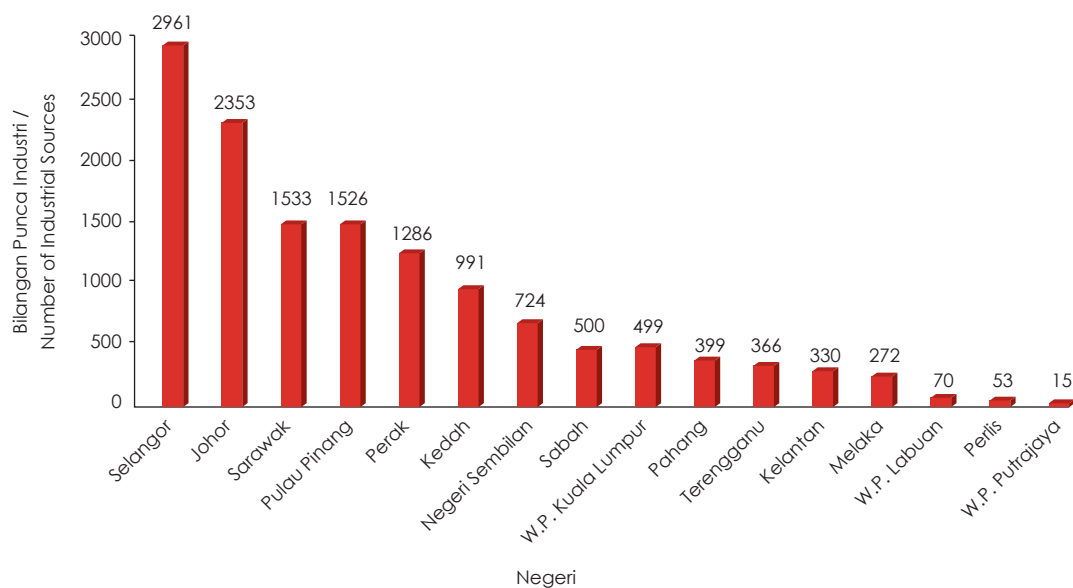
Seperti tahun-tahun yang lepas, pelepasan asap dari kenderaan bermotor merupakan punca utama yang menyumbang kepada pencemaran udara terutamanya di kawasan bandar. Pada tahun 2016, terdapat peningkatan bagi jumlah keseluruhan kenderaan bermotor yang didaftarkan. Bilangan pendaftaran yang direkodkan bagi kenderaan penumpang meningkat sebanyak 11.16%, motosikal 5.73%, kenderaan barangan 2.38%, manakala teksi dan bas menurun 7.22% dan 9.94% berbanding pada tahun 2015. Pendaftaran kenderaan bermotor yang direkodkan oleh Jabatan Pengangkutan Jalan pada tahun 2015 dan 2016 adalah seperti yang ditunjukkan dalam **Rajah 5.8**. Bilangan bagi kenderaan yang sedang digunakan dan yang masih aktif juga menunjukkan tren peningkatan, dimana bilangan bagi kenderaan penumpang meningkat sebanyak 3.72%, motosikal sebanyak 0.60%, kenderaan barangan sebanyak 0.06% dan teksi sebanyak 2.47% jika dibandingkan dengan tahun 2015 (**Rajah 5.9**). Manakala, bagi bas, ianya masih menunjukkan penurunan sebanyak 9.04% berbanding tahun 2015.

SOURCES OF AIR POLLUTION

The increasing number of industrial sources and motor vehicles can cause severe air pollution if the emission from both sources are not effectively controlled.

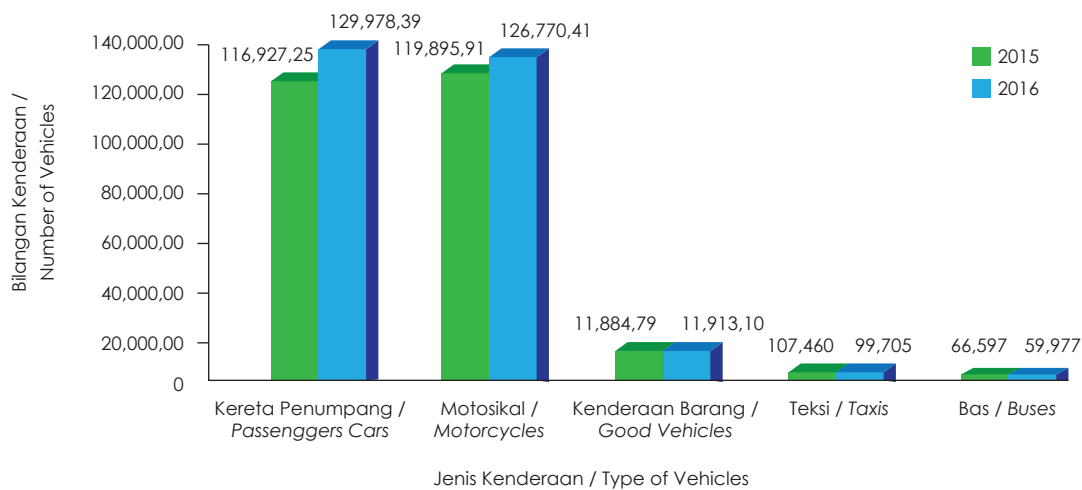
As of December 2016, a total of 13,878 industrial sources were subjected to the Environmental Quality (Clean Air) Regulations 2014. The distribution of industrial sources by states is as shown in **Figure 5.7**. Selangor shows the highest number of pollutants (2,961:21%) followed by Johor (2,350:17%) and Sarawak (1,533:11%).

As in previous years, emissions from motor vehicles remained the major source of air pollution especially in urban areas. In 2016, there was an increase in the total number of motor vehicles registered. The number of registered passenger cars had increased by 11.16%, motorcycles by 5.73%, goods vehicles by 2.38%, while number of taxi and buses had decreased by 7.22% and 9.94% respectively compared to 2015. The number of registered vehicles in Malaysia as reported by the Road Transport Department for 2015 and 2016 is shown in **Figure 5.8**. The number of in use vehicles or active on the road also has shown an ascending trend in which the number of passenger vehicles has increased by 3.72%, motorcycles increased by 0.60%, goods vehicles increased by 0.06% and taxis increased 2.47% compared to 2015 (**Figure 5.9**). While for the buses, it shows a decrease of 9.04% compared to 2015.



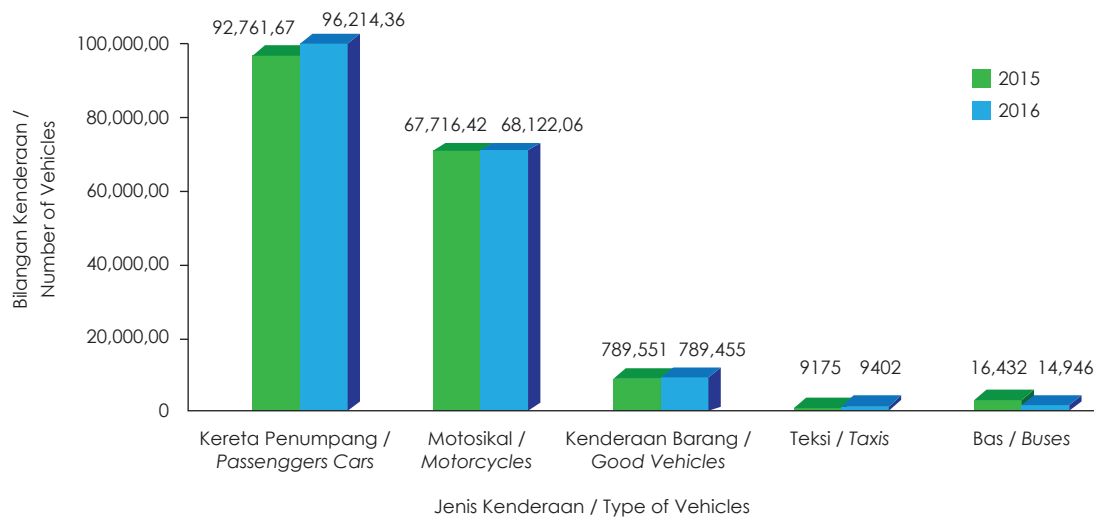
Rajah 5.7 Malaysia : Punca Pencemaran Udara Mengikut Negeri, 2016
Figure 5.7 Malaysia : Industrial Air Pollution Sources by State, 2016

(Sumber: Sistem Inventori Pencemaran Alam Sekitar (SIMPAS), Jabatan Alam Sekitar)
(Sources: Environmental Pollution Inventory System (SIMPAS), Department of Environment)



Rajah 5.8 Malaysia: Bilangan Kenderaan Berdaftar Tahun 2015–2016
Figure 5.8 Malaysia: Number of Registered Vehicles in 2015–2016

(Sumber: Jabatan Pengangkutan Jalan, Malaysia 2016)
(Source: Road Transport Department, Malaysia, 2016)



Rajah 5.9 Malaysia : Bilangan Kenderaan Aktif Tahun 2015-2016
Figure 5.9 Malaysia : Number of in Use Vehicles in 2015-2016

(Sumber: Jabatan Pengangkutan Jalan, Malaysia 2016)
(Source: Road Transport Department, Malaysia, 2016)

BEBAN PENCEMARAN PENCEMAR UDARA

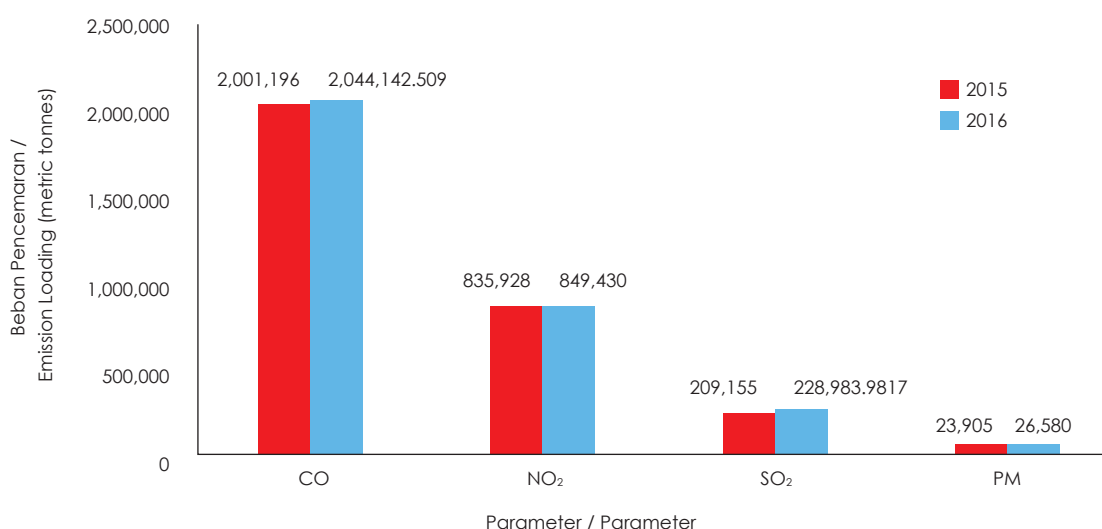
Beban Pencemaran Secara Menyeluruh

Dianggarkan pada tahun 2016, keseluruhan beban pencemaran yang terkumpul bagi pencemar karbon monoksida (CO) adalah 2,044,143 metrik tan; 849,430 metrik tan bagi nitrogen dioksida (NO₂); 228,984 metrik tan bagi sulfur dioksida (SO₂) dan 26,580 metrik tan bagi jirim zarah (PM). Perbezaan keseluruhan beban pencemaran bagi tahun 2015 dan 2016 adalah ditunjukkan dalam **Rajah 5.10**.

AIR POLLUTANT EMISSION LOAD

Overall Emission Load

It is estimated that in 2016 the combined air pollutant emission load accumulated to 2,044,143 metric tonnes of carbon monoxide (CO); 849,430 metric tonnes of nitrogen oxides (NO₂); 228,984 metric tonnes of sulphur dioxide (SO₂) and 26,580 metric tonnes of particulate matter (PM). A comparison of the combined air pollutant emission load in 2015 and 2016 is shown in **Figure 5.10**.



Rajah 5.10 Malaysia: Beban Pencemaran Bahan Pencemar Udara Dari Semua Punca, 2015-2016
Figure 5.10 Malaysia: Air Pollutant Emission Load from All Sources, 2015-2016

Beban pencemaran bagi CO meningkat pada tahun 2016 berbanding dengan 2015 disebabkan oleh peningkatan penggunaan bahan api minyak dan arang batu sebagai bahan api dalam industri dan loji janakuasa (Sumber: National Energy Balance, 2014). Peningkatan sebanyak 2.1% beban pencemar CO, 9.5% bagi beban pencemar SO₂, dan 11.2% bagi beban pencemar PM berbanding dengan tahun 2015.

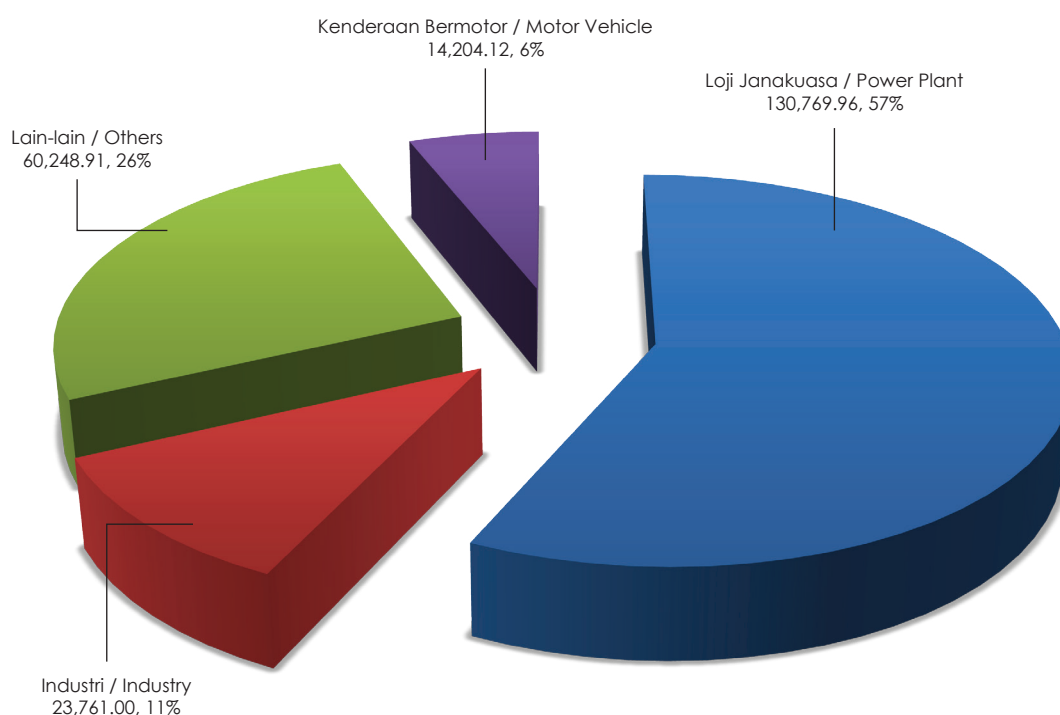
The emission load for CO had increased in 2016 compared to 2015 due to high consumptions of fuel oil and coke which were used as fuels in industries and, power and heat generation plants (Sources: National Energy Balance 2014). An increase of 2.1% in CO emission load, 9.5% in SO₂ emission load and 11.2% in PM emission load compared to 2015.

Punca Beban Pencemaran

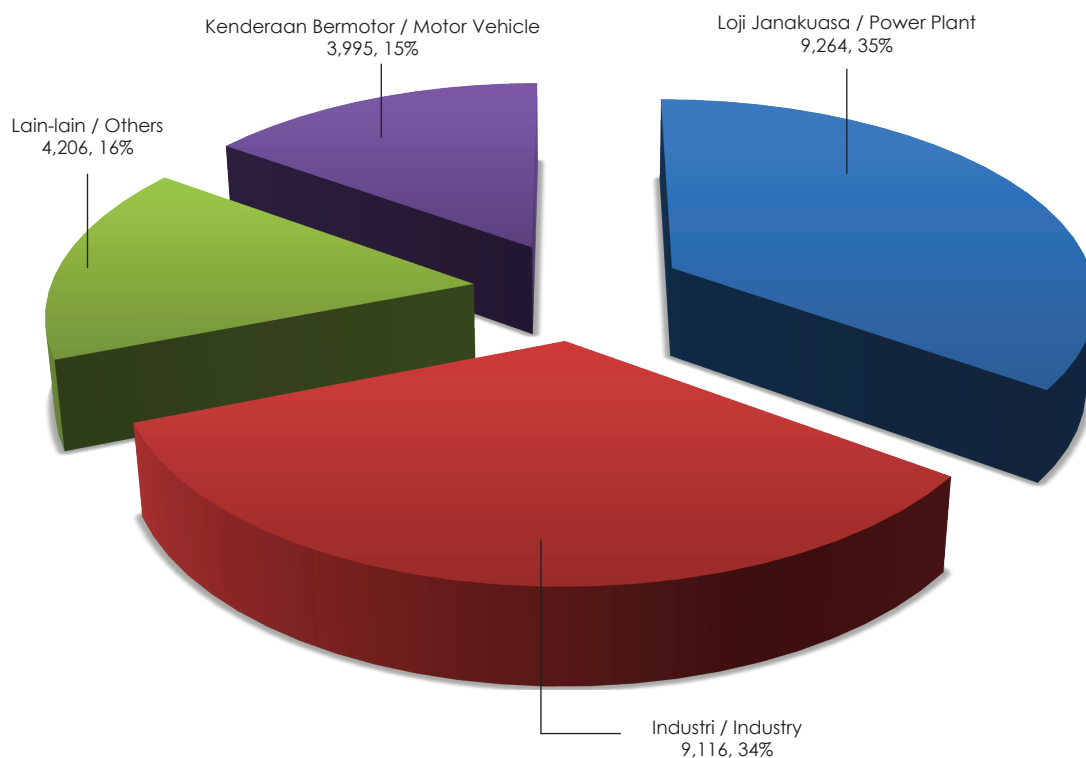
Loji janakuasa merupakan penyumbang utama kepada beban pencemar SO_2 (57%), diikuti dengan lain-lain kategori (26%), industri (11%) dan kenderaan bermotor (6%) (**Rajah 5.11**). Bagi beban pencemar PM pula, penyumbang terbesar adalah daripada loji janakuasa (35%), industri (34%), diikuti lain-lain kategori (16%) dan kenderaan bermotor (15%) (**Rajah 5.12**). Seperti yang ditunjukkan dalam **Rajah 5.13**, penyumbang terbesar bagi NO_2 adalah daripada loji janakuasa (66%) diikuti kenderaan bermotor (26%), industri (7%) dan lain-lain kategori (1%). Walau bagaimanapun, kenderaan bermotor masih merupakan penyumbang terbesar kepada CO (95%) (**Rajah 5.14**). Punca-punca bagi kategori 'Lain-lain' yang dinyatakan di dalam rajah-rajah di atas adalah merupakan pelepasan bahan pencemar udara dari kawasan perumahan, komersial, non-energy use and agriculture.

Emission Load by Sources

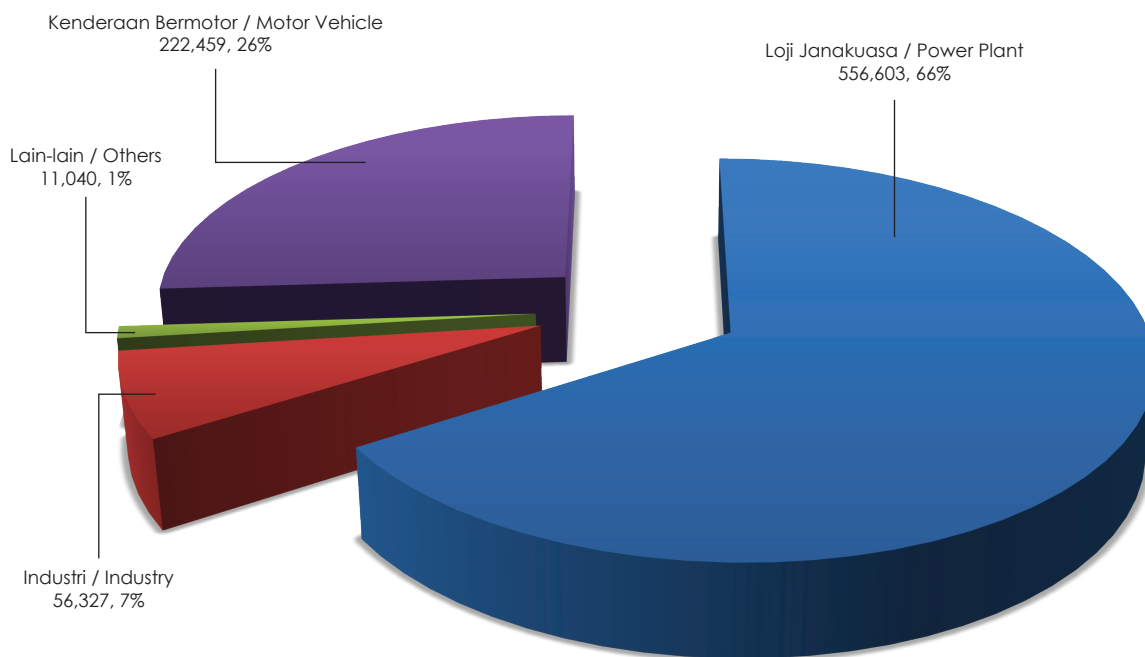
Power plants contributed the highest SO_2 emission load (57%), followed by others (26%), industries (11%) and motor vehicles (6%) (**Figure 5.11**). As for PM, the highest contributor was from power plants (35%) followed by industries (34%), others (16%) and motor vehicles (15%) (**Figure 5.12**). As shown in **Figure 5.13** the highest contributor of NO_2 was from power plants (66%) followed by motor vehicles (26%), industries (7%), and others (1%). However, motor vehicles remained the highest contributor of CO (95%) (**Figure 5.14**). 'Others' in the figures represent air pollutant sources from residential, commercial, non-energy use and agriculture.



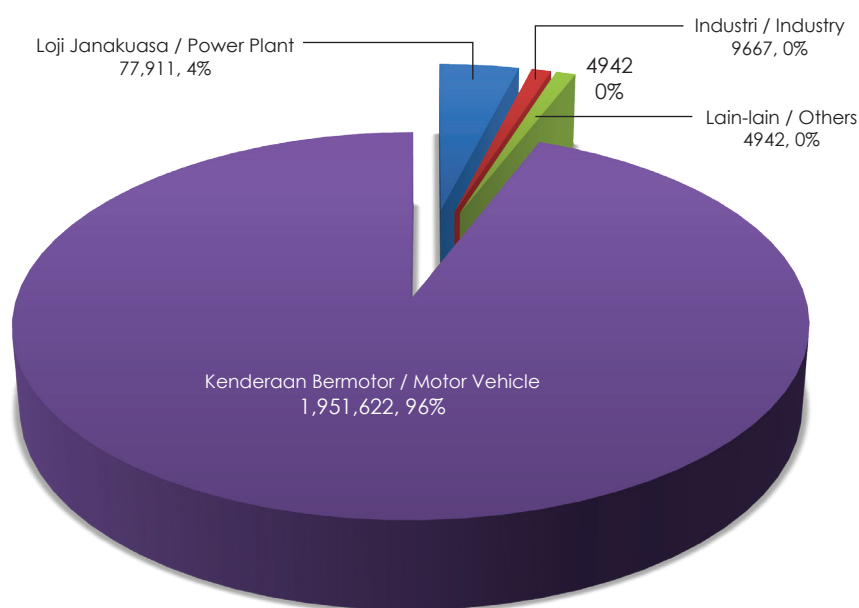
Rajah 5.11 Malaysia : Punca Pecemaran SO_2 (Metrik Tan), 2016
Figure 5.11 Malaysia : SO_2 Emission by Sources (Metric Tonnes), 2016



Rajah 5.12 Malaysia : Punca Beban Pencemaran Jirim Zarah (PM) (Metrik Tan), 2016
 Figure 5.12 Malaysia : Particulate Matter (PM) Emission Load by Sources (Metric Tonnes), 2016



Rajah 5.13 Malaysia : Punca Pencemaran NO₂ (Metrik Tan), 2016
 Figure 5.13 Malaysia : NO₂ Emission by Sources (Metric Tonnes), 2016



Rajah 5.14 Malaysia : Punca Pencemaran CO (Metrik Tan), 2016
 Figure 5.14 Malaysia : CO Emission by Sources (Metric Tonnes), 2016

Anggaran pencemaran yang dihasilkan oleh beban pencemar udara daripada kenderaan bermotor iaitu PM, SO₂, NO₂, HC dan CO, pada tahun 2015 dan 2016 ditunjukkan dalam **Rajah 5.15**. Pada tahun 2016, beban pencemaran bagi pencemar HC dan CO dianggarkan 442,000 metrik tan dan 1,951,622 metrik tan masing-masing. Terdapat peningkatan sebanyak 1.2% bagi beban pencemar HC dan 2.3% bagi beban pencemaran CO jika dibandingkan dengan tahun 2015.

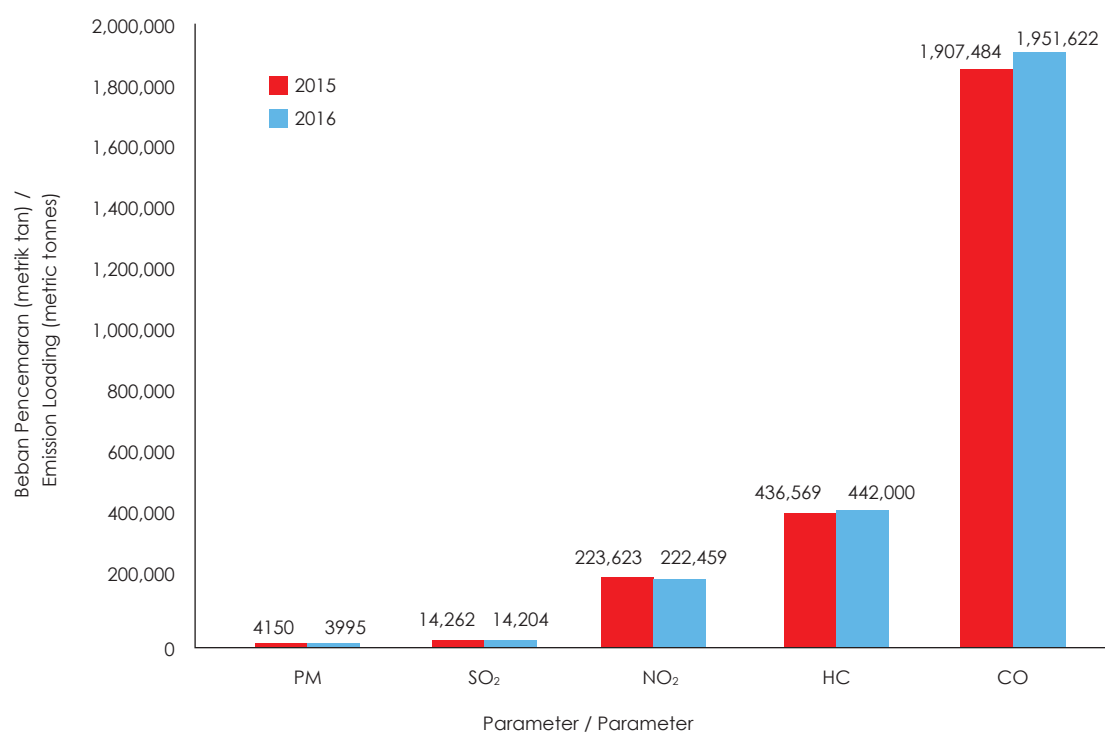
Terdapat penurunan jumlah beban pencemaran bagi pencemar PM, SO₂ dan NO₂ bagi tahun 2016 berbanding 2015. Pada tahun 2016, terdapat penurunan sebanyak 3.7% bagi pencemar PM iaitu 3,995 metrik tan berbanding 4,150 metrik tan pada 2015. Pencemar SO₂ daripada kenderaan bermotor pada tahun 2016 adalah 14,204 metrik tan berbanding 14,262 metrik tan pada tahun 2015 (penurunan sebanyak 0.03%). Manakala bagi pencemar NO₂ dianggarkan 222,459 metrik tan pada 2016 dan sebanyak 223,623 metrik tan pada 2015 (penurunan sebanyak 0.5%).

The estimated annual air pollutant emission load of PM, SO₂, NO₂, HC and CO from motor vehicles for 2015 and 2016 is shown in **Figure 5.15**. In 2016, the emission loads of HC and CO were estimated to be 442,000 metric tonnes and 1,951,622 metric tonnes, respectively. There was an increase of 1.2% of HC and 2.3% of CO emission load compared to 2015.

However, a decreasing trend was observed for the emission load of PM, SO₂, and NO₂ from motor vehicles compared to 2015. For 2016, PM was 3,995 metric tonnes compared to 4,150 metric tonnes in 2015 (3.7% decreased). SO₂ was 14,204 metric tonnes in 2016 as compared to 14,262 metric tonnes in 2015 (decreased 0.03%); and NO₂ was 222,459 metric tonnes as compared to 223,623 metric tonnes in 2015 (0.5% decreased).

Penurunan beban pencemar dari kenderaan bermotor ini adalah berkait rapat dengan pengurangan bilangan kenderaan bermotor diesel iaitu 283,769 buah kenderaan berbanding 291,699 buah kenderaan pada tahun 2015 (penurunan sebanyak 2.7%) serta penggunaan diesel Euro 5 dan petrol Euro 4M RON 97 yang telah digunapakai secara meluas.

The decrease of the above air pollutant emission loads were resulted from the number of diesel vehicles has dropped from 283,769 units in 2015 to 291,699 units in 2016 (2.7% decreased) and also may be due to the usage better fuel quality Euro 5 diesel and Euro 4M RON 97 petrol which is widely available in the market.



Rajah 5.15 Malaysia : Beban Pencemaran Pencemar Udara Dari Kenderaan Bermotor, 2015-2016
Figure 5.15 Malaysia : Air Pollutant Emission Load from Motor Vehicles, 2015-2016

INVENTORI BUANGAN TERJADUAL

Pada tahun 2016, sebanyak 2,766,613.45 tan metrik buangan terjadual telah dihasilkan. Ini mewakili penurunan keseluruhan sebanyak 5.2% berbanding 2,918,478.34 tan metrik yang dilaporkan pada 2015. Dros / sanga / klinker / abu, buangan gipsium dan enapcemar logam berat merupakan kategori utama dalam kategori buangan yang dihasilkan (**Jadual 5.1**). Negeri Johor telah menghasilkan jumlah terbesar buangan terjadual (24.7%), diikuti oleh Negeri Terengganu (14.8%), Perak (14.4%), Selangor (14.0%), Sarawak (13.4%), manakala 10 negeri-negeri yang lain menghasilkan sebanyak 18.7%.

Sebanyak 863,124.13 tan metrik (31.20%) daripada jumlah buangan yang dihasilkan diperoleh kembali di dalam dan luar negara. Ini menunjukkan peningkatan sebanyak 92% berbanding 452,956.76 tan metrik pada tahun 2015. Daripada jumlah itu, 863,124.13 tan metrik (31.20%) daripada buangan terjadual yang diperolehkembali di kemudahan pemerolehan kembali luar tapak tempatan dan 6,562.13tan metrik (0.24%) telah dieksport untuk pemerolehan kembali di kemudahan di luar negara.

Sebanyak 174,803.74 tan metrik (6.32%) daripada jumlah buangan terjadual yang dihasilkan, dirawat dan dilupuskan untuk pelupusan akhir, iaitu di Kualiti Alam Sdn. Bhd (143,063.40 MT), Trienekens (Sarawak) Sdn. Bhd (15,449.75 MT) dan 16,290.59 tan metrik (0.59%) daripada buangan klinikal telah dibakar dan dilupuskan di kemudahan luar tapak yang dilesenkan (**Jadual 5.2**). Jumlah ini menunjukkan kenaikan sebanyak 5.92% daripada sejumlah 165,028.05 tan metrik sisa berjadual dilupuskan pada tahun 2015.

SCHEDULED WASTES INVENTORY

In 2016, a total of 2,766,613.45 metric tonnes of scheduled wastes were generated. This represents an overall decrease of 5.2% as compared to 2,918,478.34 metric tonnes reported in 2015. From the total waste generated, gypsum, heavy metal sludge, dross/slag/clinker/ash, spent acid, and waste of non-halogenated solvent were the main categories of waste from the category of waste generated (**Table 5.1**). State of Johor generated the largest amount of scheduled wastes (24.7%), followed by Terengganu (14.8%), Perak (14.4%), Selangor (14.0%), Sarawak (13.4%), whilst the other 10 states generated a total of 18.7%.

A total of 863,124.13 metric tonnes (31.20%) of waste were being recovered locally and abroad. This showed an increase of 92.0% as compared to 452,956.76 metric tonnes in 2015. From the total, 863,124.13 metric tonnes (31.20%) of scheduled wastes were recovered at local off-site facilities and 6,562.13 metric tonnes (0.24%) were exported for recovery at foreign facilities abroad.

A total of 174,803.74 metric tonnes (5.30%) of waste were treated and disposed for final disposal, at Kualiti Alam Sdn. Bhd. (143,063.40 MT), Trienekens (Sarawak) Sdn. Bhd. (15,449.75 MT) and 16,290.59 metric tonnes (0.59%) of clinical wastes were incinerated at licensed off-site facilities (**Table 5.2**). The amount showed an increase of 5.92% from a total of 165,028.05 metric tonnes of scheduled waste disposed in 2015.

Sebanyak 526,860.72 tan metrik (19.04%) daripada buangan terjadual terhasil telah diolah di tapak; manakala 234,599.41 tan metrik (8.48%) telah distor di premis pengeluaran buangan (**Jadual 5.3**).

Daripada jumlah buangan terjadual yang dihasilkan pada tahun 2016, 960,663.32 tan metrik (34.72%) telah diberi kelulusan bersyarat di bawah pengurusan khas seperti yang ditetapkan di bawah Peraturan 7, Peraturan Kualiti Alam Sekeliling (Buangan Terjadual), 2005 (**Jadual 5.4**). Jumlah ini merupakan penurunan sebanyak 38.22% berbanding 1,555,003.07 tan metrik pada tahun 2015. Kebanyakan buangan dihasilkan dari loji jana kuasa arang batu (76.34%), enap cemar daripada kemudahan rawatan air minuman (2.36%) dan lain-lain (21.3%) .

A sum of 526,860.72 metric tonnes (19.04%) of scheduled waste were treated on-site; while 234,599.41 metric tonnes (8.48%) were stored on-site at waste generators' premises (**Table 5.3**).

Of the total wastes produced in 2016, 960,663.32 metric tonnes (34.72%) were granted conditional approval to be managed under special management as stipulated under Regulation 7, Environmental Quality (Scheduled Wastes) Regulations, 2005 (**Table 5.4**). The amount represented a decrease of 38.22% as compared to 1,555,003.07 metric tonnes in 2015. These waste streams are mostly generated from coal-fired power plant (76.34%), sludges from drinking water treatment facilities (2.36%) and others (21.3%).

Jadual 5.1 Malaysia : Jumlah Buangan Terjadual Yang Dihasilkan Mengikut Kod Buangan Terjadual, 2016
Table 5.1 Malaysia : Quantity of Scheduled Wastes Generated by Scheduled Waste Code, 2016

BIL / NO	NAMA BUANGAN / NAME OF WASTE	KOD BUANGAN / WASTE CODE	KUANTITI BUANGAN / QUANTITY OF WASTE	
			(MT/TAHUN) / (MT/YEAR)	PERATUSAN / PERCENTAGE (%)
1	Dros / sanga / klinker / abu <i>Dross / Slag / Clinker / Ash</i>	SW 104	1,222,505.18	44.19
2	Gypsum <i>Gypsum</i>	SW 205	558,142.71	20.17
3	Enap cemar logam berat <i>Heavy Metal Sludges</i>	SW 204	376,526.83	13.61
4	Asid Terpakai <i>Spent Acids</i>	SW 206	65,693.37	2.37
5	Minyak Pelincir Terpakai <i>Spent Lubricating oil</i>	SW 305	56,572.23	2.04
6	Buangan elektronik <i>E-Waste</i>	SW 110	48,787.37	1.76
7	Campuran buangan terjadual dan buangan tidak terjadual <i>Mixture of Scheduled Waste & Non-Scheduled Waste</i>	SW 422	41,368.51	1.50
8	Bekas tercemar <i>Contaminated Container</i>	SW 409	33,209.99	1.20
9	Buangan getah atau lateks yang mengandungi logam berat <i>Rubber / Latex Waste Containing Heavy Metal</i>	SW 321	30,315.10	1.10
10	Buangan pelarut organik bukan terhalogen <i>Waste of Non-Halogenated Solvent</i>	SW 322	28,995.97	1.05

Jadual 5.1 Malaysia : Jumlah Buangan Terjadual Yang Dihasilkan Mengikut Kod Buangan Terjadual, 2016
Table 5.1 Malaysia : Quantity of Scheduled Wastes Generated by Scheduled Waste Code, 2016

BIL / NO	NAMA BUANGAN / NAME OF WASTE	KOD BUANGAN / WASTE CODE	KUANTITI BUANGAN / QUANTITY OF WASTE	
			(MT/TAHUN) / (MT/YEAR)	PERATUSAN / PERCENTAGE (%)
11	Buangan minyak atau enap cemar berminyak <i>Waste oil / Oily sludges</i>	SW 311	27,870.52	1.01
12	Emulsi minyak mineral-air terpakai <i>Spent mineral oil-water emulsion</i>	SW 307	24,150.71	0.87
13	Buangan patogenik / klinikal <i>Pathogenics Clinical Waste</i>	SW 404	23,844.91	0.86
14	Enap cemar mineral <i>Mineral sludges</i>	SW 427	22,102.77	0.80
15	Buangan dakwat dan cat <i>Waste of inks & paints</i>	SW 417	21,297.97	0.77
16	Kain buruk, plastik, kertas atau turas tercemar <i>Rags/Plastics/Papers contaminated with Scheduled Waste</i>	SW 410	21,169.82	0.77
17	Buangan kimia <i>Lab Waste</i>	SW 429	14,945.04	0.54
18	Dadah terbuang <i>Expired Drug</i>	SW 403	14,250.60	0.52
19	Sisa dari pengolahan atau pemerolehan kembali buangan terjadual <i>Residue from recovery</i>	SW 501	12,248.24	0.44
20	Enap cemar yang mengandungi fluorida <i>Sludge containing flouride</i>	SW 207	10,405.42	0.38
21	Produk dakwat, cat, pigmen atau lakuer yang tidak mengikut spesifikasi yang mengandungi pelarut organik <i>Discarded of ink / paint / pigment / lacquer containing organic solvent</i>	SW 418	9,329.53	0.34
22	Buangan bateri asid plumbum <i>Waste of acid plumbum batteries</i>	SW 102	8,706.29	0.31
23	Buangan pelekat / glu yang mengandungi pelarut organik <i>Adhesive / glue containing organic solvent</i>	SW 303	7,815.35	0.28
24	Buangan mangkin <i>Waste catalyst</i>	SW 202	6,797.14	0.25
25	Alkali terpakai <i>Spent alkalis</i>	SW 401	6,668.99	0.24
26	Karbon teraktif terpakai <i>Contaminated active carbon</i>	SW 411	6,462.43	0.23
27	Enap cemar dakwat dan cat <i>Ink & paint sludges</i>	SW 416	5,519.73	0.20
28	Buangan mengandungi formaldehid <i>Waste containing formaldehyde</i>	SW 320	5,286.70	0.19
29	Sisa berminyak dari bengkel automotif <i>Oily residue from workshop</i>	SW 312	4,495.93	0.16
30	Minyak hidraulik terpakai <i>Spent hydraulic oil</i>	SW 306	4,068.61	0.15
31	Minyak / Enapcemar daripada loji penapisan minyak <i>Oil / sludges from oil refinery</i>	SW 314	3,949.01	0.14

Jadual 5.1 Malaysia : Jumlah Buangan Terjadual Yang Dihasilkan Mengikut Kod Buangan Terjadual, 2016
 Table 5.1 Malaysia : Quantity of Scheduled Wastes Generated by Scheduled Waste Code, 2016

BIL / NO	NAMA BUANGAN / NAME OF WASTE	KOD BUANGAN / WASTE CODE	KUANTITI BUANGAN / QUANTITY OF WASTE	
			(MT/TAHUN) / (MT/YEAR)	PERATUSAN / PERCENTAGE (%)
32	Campuran minyak-air <i>Oil-water mixture</i>	SW 309	3,759.63	0.14
33	Campuran buangan terjadual <i>Mixture of scheduled waste</i>	SW 421	3,593.56	0.13
34	Buangan pelarut organik terhalogen <i>Waste of halogenated solvents</i>	SW 323	3,485.81	0.13
35	Alkali terpakai dengan pH ≥ 11.5 <i>Spent alkalis with pH ≥ 11.5</i>	SW 402	3,050.40	0.11
36	Buangan resin yang mengandungi pelarut organik <i>Waste of resin containing organic</i>	SW 325	2,999.21	0.11
37	Klinker, sanga dan abu dari penunu buangan terjadual <i>Clinker, slag and ashes from incinerator</i>	SW 406	2,656.09	0.10
38	Enap cemar dari tangki minyak <i>Oil tankers sludges</i>	SW 308	2,651.40	0.10
39	Buangan cecair terma <i>Waste of thermal fluids</i>	SW 327	2,535.49	0.09
40	Buangan mengandungi merkuri <i>Waste containing mercury / compound</i>	SW 109	2,321.69	0.08
41	Tanah / puing tercemar <i>Contaminated land / oil</i>	SW 408	2,268.57	0.08
42	Larutan alkali berair terpakai yang mengandungi sianida <i>Spent aqueous alkaline containing cyanide</i>	SW 414	1,909.83	0.07
43	Buangan sisa penyulingan tidak berair terhalogen atau bukan terhalogen <i>Waste of halogenated or unhalogenated non-aqueous distillation residues arising from organic solvent recovery process</i>	SW 324	1,486.84	0.05
44	Enap cemar dari tangki penyimpanan minyak mineral <i>Sludges from mineral oil storage tank</i>	SW 310	1,359.40	0.05
45	Asid organik terpakai <i>Spent organic acids</i>	SW 301	1,323.04	0.05
46	Garam terpakai yang mengandungi sianida <i>Spent salt containing cyanide</i>	SW 413	1,155.64	0.04
47	Buangan bateri yang mengandungi cadmium dan nikel <i>Waste of batteries containing cadmium / hg / lithium</i>	SW 103	1,133.04	0.04
48	Enap cemar yang distabilkan <i>Stabilized sludges</i>	SW 203	877.28	0.03
49	Tar atau sisa bertar dari loji penapisan minyak <i>Tar residue from oil refinery / petrochemical plant</i>	SW 315	715.12	0.03
50	Buangan makmal <i>Chemical waste</i>	SW 430	714.82	0.03
51	Buangan fotografi <i>Photographic waste</i>	SW 423	653.14	0.02
52	Buangan asbestos <i>Asbestos</i>	SW 201	484.54	0.02

Jadual 5.1 Malaysia : Jumlah Buangan Terjadual Yang Dihasilkan Mengikut Kod Buangan Terjadual, 2016
Table 5.1 Malaysia : Quantity of Scheduled Wastes Generated by Scheduled Waste Code, 2016

BIL / NO	NAMA BUANGAN / NAME OF WASTE	KOD BUANGAN / WASTE CODE	KUANTITI BUANGAN / QUANTITY OF WASTE	
			(MT/TAHUN) / (MT/YEAR)	PERATUSAN / PERCENTAGE (%)
53	Buangan yang mengandungi arsenik <i>Waste containing arsenic</i>	SW 101	480.80	0.02
54	Buangan farmaseutikal <i>Discarded drug</i>	SW 405	337.77	0.01
55	Produk racun perosak yang tidak mengikut spesifikasi <i>Used pesticide / herbicides / biocides</i>	SW 426	306.24	0.01
56	Tanah yang dicemari dengan minyak daripada penapisan semula minyak pelincir terpakai <i>Contaminated oil from re-refining / used lubricating oil</i>	SW 313	198.93	0.01
57	Buangan sebatian fosforus organik <i>Waste of organic phosphorus compound</i>	SW 326	140.08	0.01
58	Buangan racun perosak <i>Pesticides</i>	SW 425	111.69	0.00
59	Buangan fluks <i>Flux waste</i>	SW 302	89.85	0.00
60	Larutan resap dari tapak pelupusan buangan terjadual <i>Leachate from scheduled waste landfill</i>	SW 420	78.40	0.00
61	Enap cemar asid <i>Acid sludges</i>	SW 316	48.17	0.00
62	Buangan yang mengandungi BFT dan TFT <i>Waste containing pcb or pct</i>	SW 318	43.64	0.00
63	Buangan yang mengandungi dioksin atau furan <i>Waste containing dioxines or furans</i>	SW 407	39.28	0.00
64	Sanga kuprum <i>Slag of copper</i>	SW 107	36.66	0.00
65	Buangan fenol <i>Waste of phenols / its compound</i>	SW 319	33.18	0.00
66	Diisosianat terpakai <i>Spent di-isocyanates</i>	SW 419	12.75	0.00
67	Buangan yang mengandungi peroksida <i>Waste containing peroxides</i>	SW 432	10.30	0.00
68	Agen pengoksidaan terpakai <i>Spent oxidizing agent</i>	SW 424	4.88	0.00
69	Enap cemar yang mengandungi sianida <i>Sludges containing cyanide</i>	SW 412	2.18	0.00
70	Buangan daripada operasi pengawetan kayu <i>Waste from wood containing heavy metals</i>	SW 428	0.55	0.00
71	Sebatian organologam terpakai <i>Spent of organometalic compound</i>	SW 317	0.20	0.00
72	Sisa dari pemprosesan zink <i>Zinc residue</i>	SW 108	0.18	0.00
73	Minyak pelindapan terpakai yang mengandungi sianida <i>Spent quenching oil containing cyanide</i>	SW 415	0.10	0.00
74	Enap cemar galvanik <i>Galvanic sludges</i>	SW 105	0.05	0.00

Jadual 5.1 Malaysia : Jumlah Buangan Terjadual Yang Dihasilkan Mengikut Kod Buangan Terjadual, 2016
 Table 5.1 Malaysia : Quantity of Scheduled Wastes Generated by Scheduled Waste Code, 2016

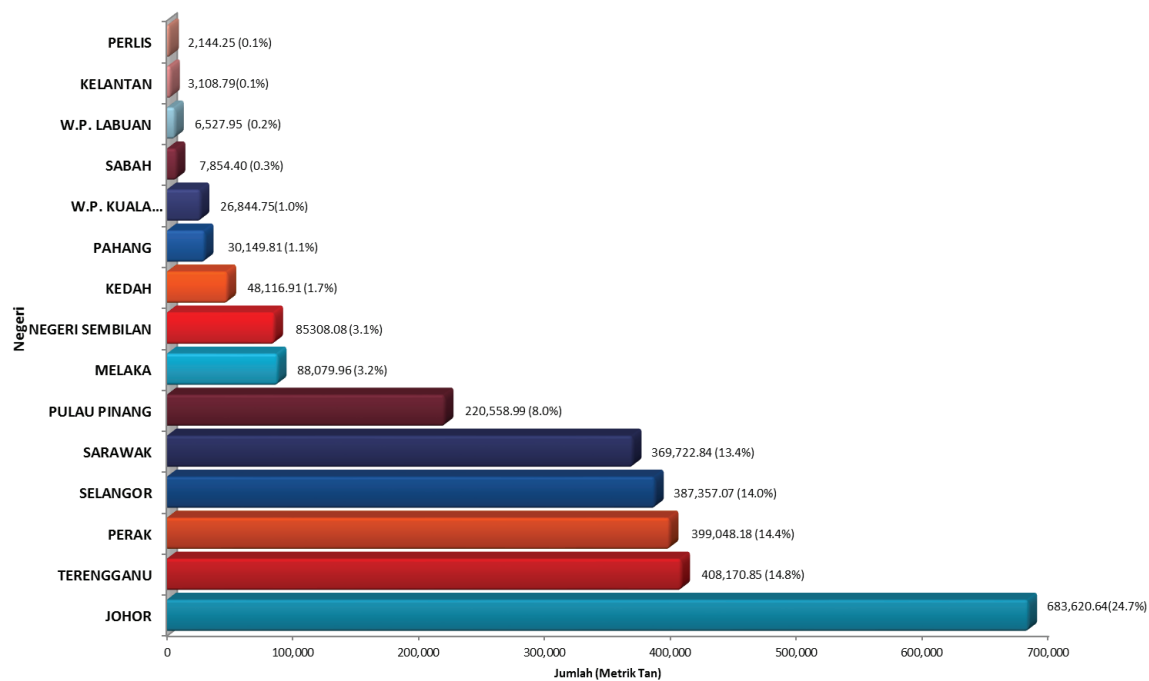
BIL / NO	NAMA BUANGAN / NAME OF WASTE	KOD BUANGAN / WASTE CODE	KUANTITI BUANGAN / QUANTITY OF WASTE	
			(MT/TAHUN) / (MT/YEAR)	PERATUSAN / PERCENTAGE (%)
75	Kek tekan daripada prapengolahan lai sabun gliserol <i>Cake from glycerol soap iye</i>	SW 304	0.05	0.00
76	Sisa dari pemerolehan kembali likuor penjerukan asid <i>Residue from recovery of acid pickling liquor</i>	SW 106	0.00	0.00
77	Buangan dari pengilangan bahan letupan <i>Waste from manufacturing / processing or use of explosive</i>	SW 431	0.00	0.00
		JUMLAH TOTAL	2,766,613.45	100.00

Jadual 5.2 Malaysia : Jumlah Buangan Terjadual Yang Dihasilkan Mengikut Jenis Industri, 2016
 Table 5.2 Malaysia : Quantity of Scheduled Wastes Generated by Industry, 2016

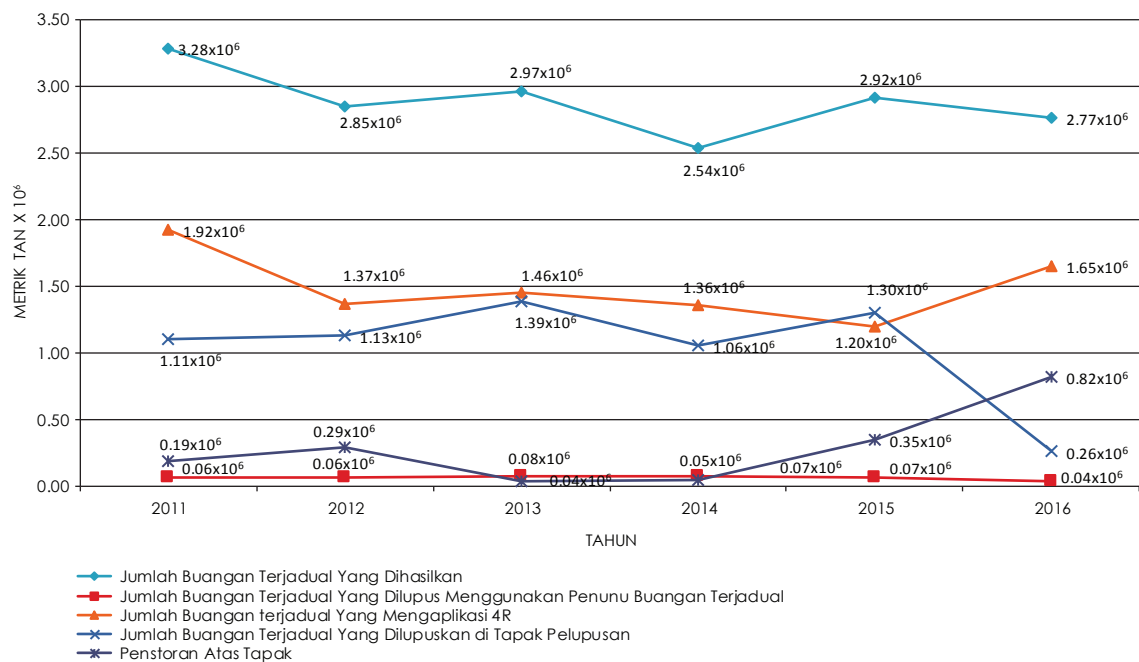
BIL / NO	JENIS INDUSTRI / TYPE OF INDUSTRY	KUANTITI BUANGAN / QUANTITY OF WASTE	
		(MT/TAHUN) / (MT/YEAR)	PERATUSAN (%) / PERCENTAGE (%)
1	Loji Janakuasa <i>Power Plant</i>	879,058.59	31.77
2	Premis Buangan Terjadual <i>Recovery Facilities</i>	558,142.71	20.17
3	Industri Kimia <i>Chemical Industry</i>	272,199.00	9.84
4	Elektrik Dan Elektronik <i>Electric and Electronic</i>	238,865.75	8.63
5	Pengilangan Logam <i>Metal Refinery</i>	235,147.30	8.50
6	Kertas <i>Paper</i>	207,878.67	7.51
7	Kenderaan <i>Vehicles</i>	56,572.23	2.04
8	Galian Bukan Logam <i>Excavation Non Metal</i>	45,624.16	1.65
9	Bengkel <i>Workshop</i>	33,856.89	1.23
10	Penapisan Petroleum <i>Petroleum Refinery</i>	30,623.57	1.11
11	Berasaskan Getah <i>Rubber Base</i>	26,489.82	0.96
12	Percetakan <i>Printing</i>	25,557.92	0.92
13	Lain-lain <i>Others</i>	25,377.94	0.92
14	Perubatan <i>Health Care Services</i>	23,844.91	0.86

Jadual 5.2 Malaysia : Jumlah Buangan Terjadual Yang Dihasilkan Mengikut Jenis Industri, 2016
Table 5.2 Malaysia : Quantity of Scheduled Wastes Generated by Industry, 2016

BIL / NO	JENIS INDUSTRI / TYPE OF INDUSTRY	KUANTITI BUANGAN / QUANTITY OF WASTE	
		(MT/TAHUN) / (MT/YEAR)	PERATUSAN (%) / PERCENTAGE (%)
15	Loji Rawatan Air <i>Water Treatment Plant</i>	22,698.75	0.82
16	Penyudahan Logam Dan Sadur Elektrik <i>Metal Finishing and Coating</i>	17,654.90	0.64
17	Fabrikasi Logam <i>Metal Fabrication</i>	9,448.50	0.34
18	Makanan & Minuman <i>Food & Drink</i>	7,892.62	0.29
19	Perlombongan <i>Mining</i>	7,878.01	0.28
20	Penapisan Minyak Makan <i>Edible Oil Refinery</i>	7,450.89	0.27
21	Kuari <i>Quarry</i>	6,111.28	0.22
22	Plastik <i>Plastic</i>	5,871.81	0.21
23	Kilang Kelapa Sawit <i>Palm Oil Mill</i>	3,913.83	0.14
24	Perkhidmatan <i>Services</i>	3,713.67	0.13
25	Gudang <i>Warehouse</i>	2,714.56	0.10
26	Jentera <i>Machinery</i>	2,302.89	0.08
27	Berasaskan Kayu <i>Wood Base</i>	2,128.11	0.08
28	Pertanian <i>Agriculture</i>	2,110.23	0.08
29	Pembuatan Payung dan Lain-lain Industri Pembuatan <i>Others Manufacturing</i>	2,068.44	0.07
30	Simen <i>Cement</i>	1,142.83	0.04
31	Tekstil <i>Textiles</i>	940.38	0.03
32	Kilang Getah <i>Rubber Factory</i>	537.89	0.02
33	Tapak Pelupusan Sampah <i>Sanitary Landfill</i>	352.71	0.01
34	Peralatan Sukan Dan Permainan <i>Sports Equipment and Games</i>	286.88	0.01
35	Peralatan Pejabat dan Alat Tulis <i>Office Supplies and Stationery</i>	154.79	0.01
JUMLAH TOTAL		2,766,613.45	100.00



Rajah 5.16 Malaysia: Penghasilan Buangan Terjadual Mengikut Negeri, 2016
 Figure 5.16 Malaysia : Distribution of Scheduled Waste Generated by State, 2016



Rajah 5.17 Malaysia : Trend Pengurusan Buangan Terjadual , 2011 - 2016
 Figure 5.17 Malaysia : The Trend of Scheduled Waste Management from 2011 - 2016

Jadual 5.3 Malaysia: Kemudahan Yang Mengendalikan Buangan Terjadual, 2016
Table 5.3 Malaysia : Facilities Handling Scheduled Wastes, 2016

NO	KEMUDAHAN	METRIK TAN	PERATUSAN (%)
1	Pengurusan Khas <i>Special Waste Management</i>	960,663.32	34.72
2	Kemudahan Pemerolehan Kembali Luar Tapak <i>Local Off-Site Recovery Facilities</i>	863,124.13	31.20
3	Pengolahan Dalam Tapak <i>On-Site Treatment</i>	526,860.72	19.04
4	Penstoran Dalam Tapak <i>On-Site Storage</i>	234,599.41	8.48
5	Kualiti Alam Sdn Bhd <i>Kualiti Alam Sdn Bhd</i>	143,063.40	5.17
6	Penunu Buangan Klinik <i>Off-Site Clinical Waste Incinerators</i>	16,290.59	0.59
7	Trienekens (Sarawak) Sdn Bhd <i>Trienekens (Sarawak) Sdn Bhd</i>	15,449.75	0.56
8	Kemudahan Luar Negara (Export) <i>Foreign Facilities (Export)</i>	6,562.13	0.24
JUMLAH TOTAL		2,766,613.45	100.00

Jadual 5.4 Malaysia: Buangan Terjadual Yang Diuruskan Di Bawah Pengurusan Khas
Table 5.4 Malaysia : Generated Scheduled Waste Managed Under Special Management

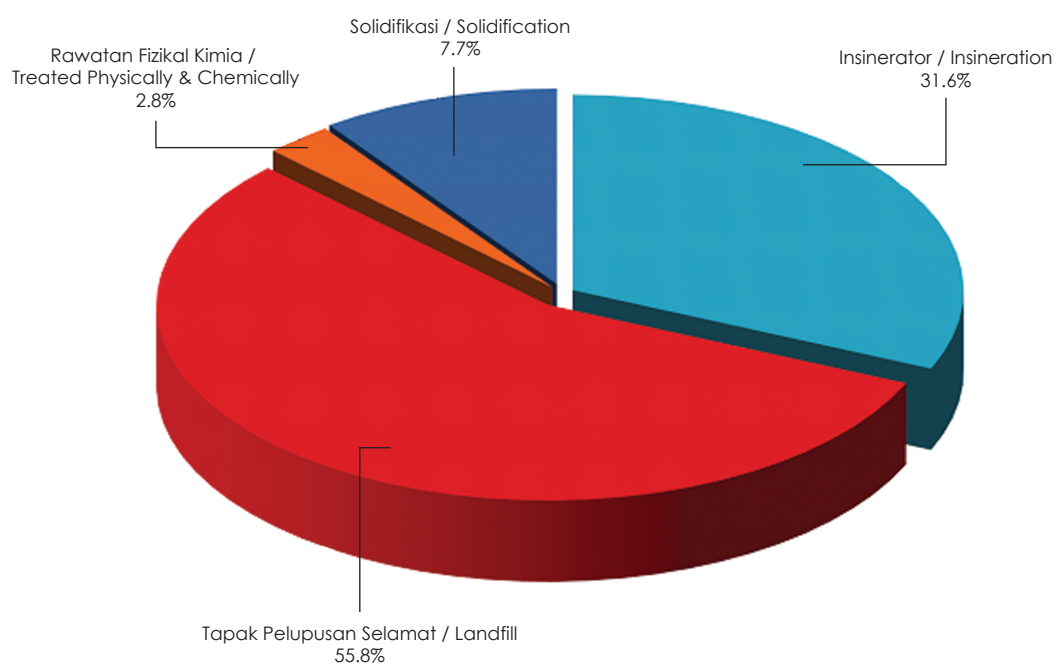
Bil / No.	Kategori Buangan / Waste Category	Kod Buangan / Waste Code	Sumber / Sources	Metrik Tan / Metric Tonnes	Peratus / Percentage (%)	Kaedah Pelupusan / Method of Disposal
1	Enap cemar Logam Berat <i>Heavy Metal Sludge</i>	SW 204	Loji Rawatan Air Minuman <i>Drinking Water Treatment Plant</i>	22,698.75	2.36	Tapak Pelupusan Sanitari <i>Sanitary Landfill</i>
				75,144.79	7.82	
			Industri <i>Industry</i>	15,496.19	1.61	Guna semula sebagai bahan mentah pembuatan produk <i>Reuse as raw material for products</i>
2	'Fly Ash' & 'Bottom Ash'	SW 104	Loji Janakuasa elektrik <i>Coal-Fired Power Plant</i>	733,377.72	76.34	Guna semula sebagai bahan mentah pembuatan produk <i>Reuse as raw material for products</i>
			Industri <i>Industry</i>	28,199.98	2.94	
3	Gypsum <i>Gypsum</i>	SW 205	Industri <i>Industry</i>	71,998.16	7.49	Tapak Pelupusan Sanitari <i>Sanitary Landfill</i>
4	Buangan yang mengandungi formaldehid, resin, serbuk epoksi <i>Waste containing formaldehyde, resin, discarded epoxy powder</i>	SW 320, 325, 418	Industri <i>Industry</i>	6,656.05	0.69	Tapak Pelupusan Sanitari <i>Sanitary Landfill</i>

Jadual 5.4 Malaysia: Buangan Terjadual Yang Diuruskan Di Bawah Pengurusan Khas
 Table 5.4 Malaysia : Generated Scheduled Waste Managed Under Special Management

Bil / No.	Kategori Buangan / Waste Category	Kod Buangan / Waste Code	Sumber / Sources	Metrik Tan / Metric Tonnes	Peratus / Percentage (%)	Kaedah Pelupusan / Method of Disposal
5	Produk farmasi terbuang, Produk terbuang <i>Discarded pharmaceutical product, discarded product</i>	SW 405, 429	Industri Industry	14.96	0.00	Tapak Pelupusan Sanitari <i>Sanitary Landfill</i>
6	Abu dari enapcemar kertas <i>Ash of Paper Sludge</i>	SW 406	Industri Industry	4,460.93	0.46	Tapak Pelupusan Sanitari <i>Sanitary Landfill</i>
7	Karbon teraktif terpakai <i>Contaminated active carbon</i>	SW411	Industri Industry	29.70	0.00	Guna semula sebagai bahan mentah pembuatan produk <i>Reuse as raw material for products</i>
8	Campuran minyak terpakai <i>Spent Mixed Oil</i>	SW 421	Industri Industry	5.10	0.00	Guna semula sebagai bahan mentah pembuatan produk <i>Reuse as raw material for products</i>
9	Enap Cemar Mineral <i>Mineral Sludge</i>	SW 427	Industri Industry	2,580.99	0.27	Gunasemula sebagai agen peneutralan <i>Reuse as neutralizing agent</i>
JUMLAH TOTAL				960,663.32	100	

Kategori buangan terjadual yang dihantar ke premis berlesen (Kualiti Alam Sdn Bhd dan Trienekens (Sarawak) Sdn Bhd) untuk pelupusan akhir adalah seperti enapcemar yang mengandungi satu atau beberapa logam berat, campuran buangan terjadual, debu/ sanga/ dros atau abu yang mengandungi arsenik/ merkuri dan asid bukan organik terpakai. Buangan tersebut sama ada dibakar, dirawat secara fizikal dan kimia, distabilkan atau dilupuskan di tapak pelupusan selamat bergantung kepada ciri-ciri tertentu. Seperti yang ditunjukkan dalam **Rajah 5.18**, kebanyakan sisa dihantar ke Kualiti Alam Sdn Bhd dan Trienekens Sdn Bhd adalah ke tapak pelupusan (55.8%), diikuti dibakar (31.6%), solidifikasi (9.9%) dan rawatan secara fizikal dan kimia (2.8%).

The categories of wastes sent to the licensed premises (Kualiti Alam Sdn Bhd and Trienekens (Sarawak) Sdn Bhd) for final disposal are sludge containing one or several heavy metals, mixed wastes, dust/ slag/ dross or ash containing arsenic/ mercury and spent inorganic acid. Such wastes were either incinerated, treated physically and chemically, solidified or disposed off in secured landfill depending on their characteristics. As shown in **Figure 5.18**, most wastes sent to Kualiti Alam Sdn Bhd and Trienekens Sdn Bhd were landfilled (55.8%), followed by incinerated (31.6%), solidified (9.9%) and treated physically and chemically (2.8%).



Rajah 5.21 Kualiti Alam and Trienekens: Jenis Rawatan dan Pelupusan Buangan Terjadual, 2016
 Figure 5.21 Malaysia : Kualiti Alam and Trienekens: Types of Treatment and Disposal of Waste, 2016