

## GUIDE TO DATA COLLECTION AND COLLATION FOR A GREENHOUSE GAS INVENTORY

SUSTAINABLE ENERGY AFRICA, 2017

### Data Sources Overview

A summary table of data sources is provided below. The remainder of the document details methods behind data collation (assigning data by sector).

Data	Source(s)
<b>INTERNAL DATA SOURCES</b>	
Electricity sales by tariff (municipal distribution areas)	Local municipality (Electricity and Finance Department)
Coal use at municipal power stations	Local municipality (Electricity Department)
Solid waste landfilled (municipal)	Local municipality; private landfill site operators
Wastewater volume and treatment method (municipal)	Local municipality, sanitation department
Types of industries and industrial processes taking place in Tshwane	Local municipality, economic development department
<b>EXTERNAL DATA SOURCES</b>	
Electricity sales by tariff (Eskom distribution areas)	Eskom
Energy (electricity, diesel) use by rail	Eskom; PRASA; Transnet
Liquid fuel sales by fuel type by magisterial district (by trade category)	Department of Energy ( <a href="http://www.energy.gov.za">www.energy.gov.za</a> )
In-boundary aviation fuel use	Flight schools (any local flying schools, private aerodromes)
Residential coal and wood use	Local studies; StatsSA ( <a href="http://www.statssa.gov.za">www.statssa.gov.za</a> )
Commercial and industrial coal and wood use	Relevant licencing authority (air quality)
Emissions factors	Department of Environmental Affairs; Eskom Integrated Report ( <a href="http://www.eskom.co.za">www.eskom.co.za</a> ); emissionfactors.com ( <a href="http://www.emissionfactors.com">www.emissionfactors.com</a> )
Gas (pipeline length, volume and purpose of gas use)	Sasol
Solid waste landfilled (private)	Private landfill site operators
Solid waste incinerated	DEA Air Quality department
Wastewater volume and treatment method (private)	Private operators
Number of livestock	Industry annual reports (Beefcor, etc.)
Industrial processes (volumes of cement, glass, etc., produced)	Industry annual reports (PPC Cement, Consol Glass, etc.)

### Emission Factors

## IPCC emissions factors

Default IPCC emissions factors, along with a list of other country-specific factors can be found on [emissionfactors.com](http://emissionfactors.com).

Website link: <http://www.emissionfactors.com/>

This website only allows a limited number of emissions factors requests unless you have an account. There are no costs involved in creating an account.

### Create an account

1. Go to the "Log in" drop-down menu on the top right of the home page.
2. Click on "Sign up here!"
3. Fill in your details to create your account

### Search for emissions factors

When you are logged in to your account, you can search for emissions factors.

1. On the left-hand-side of the page, choose "Search"

The easiest is to search under "Emission Source Search" rather than "Raw Factor Search", as the "Emission Source Search" includes unit conversions, e.g. if you want an emissions factor for petrol in kg CO<sub>2</sub>/lit rather than kg CO<sub>2</sub>/TJ, you can easily switch between the two, rather than doing this conversion yourself.

2. Under "Year", choose "This Year". Default 2006 IPCC figures are still included in search results, even when choosing "This Year".
3. Under "Location", type "South Africa". It will pop up as an option in a drop-down menu as you type. Choose "South Africa" in the drop-down menu.

You can get very detailed emissions factors on this website, such as the emissions per kilometres travelled in an SUV in America, but generally the default factors for a particular fuel are what you are looking for, unless there are specific factors available for South Africa.

4. In the "Category" drop-down list, choose "Fuel, various"
5. Choose your fuel of interest. Generally the ones we are interested in is:
  - a. Aviation gasoline: usually used in small, private aircraft. I have no idea why they list it as "stationary combustion" when it is actually mobile combustion
  - b. CNG (compressed natural gas) – if natural gas is used in your area
  - c. Diesel (100% mineral)
  - d. Jet kerosene (i.e. jet fuel): usually used in large, commercial aircraft



- e. Kerosene (i.e. paraffin)
  - f. LPG (Liquefied Petroleum Gas)
  - g. Lubricants (if data can be obtained on lubricant use / sales)
  - h. Petrol (100% mineral)
  - i. Residual fuel oil (also known as heavy fuel oil or fuel oil)
6. Click “Update Results”. Do not leave out this step, as you may by mistake draw old data unknowingly from a previous search.
  7. In the Matching Units table, you can choose which units you want when reporting your emissions factor, e.g. if your activity data (such as sale of petrol) is in litres, you would want your emissions factor to be in kg/litre (rather than in kg/GJ or kg/barrel, etc.). Scroll down on the left and click on your unit of choice, e.g. litres.
  8. The Computed Factors given at the top are the ones of interest. It is created by calculating the emissions factor for your activity data. Example: If you chose litres as your activity data for petrol, it uses the 2006 IPCC factors (which are in kg of greenhouse gas per TJ petrol) and energy conversion figures from EPA (which converts TJ to litres) to give you kg greenhouse gas per litre petrol. That is why there are two data sources for your emissions factor, e.g. IPCC 2006 (original emissions factor) and EPA 2016 (energy conversion factor).

### Eskom emissions factors

The latest Eskom emissions factors can be found in their annual / integrated report on their website:

[http://www.eskom.co.za/OurCompany/Investors/IntegratedReports/Pages/Annual\\_Statements.aspx](http://www.eskom.co.za/OurCompany/Investors/IntegratedReports/Pages/Annual_Statements.aspx)

In the older reports, Eskom only reported a CO<sub>2e</sub> factor (i.e. the combined carbon dioxide equivalent emissions of CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O), but in the more recent reports it splits the emissions factor into the separate gases (i.e. kg of CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O.), which is preferable for GPC reporting (but not required if not available for your year of reporting).

Emissions factors are provided for electricity without Transmission and Distribution (T&D) losses and for electricity with T&D losses. Example (for illustrative purposes only – do not use these factors):

	kg CO <sub>2</sub> /kWh (with T&D losses)	kg CO <sub>2</sub> /kWh (without T&D losses)
CO <sub>2</sub>	1.03	0.99
CH <sub>4</sub>	...	...
N <sub>2</sub> O	...	...

The factor(s) without T&D losses should be used as the emissions factor for electricity consumed under **scope 2** in all the GPC sectors (stationary energy, transport, etc.).

The emissions factors for **scope 3** (electricity T&D losses) can be calculated as the difference between the factor with losses and the one without, i.e.

	kg CO <sub>2</sub> /kWh (with T&D losses)	kg CO <sub>2</sub> /kWh (without T&D losses)	kg CO <sub>2</sub> /kWh (losses)
CO <sub>2</sub>	1.03	0.99	1.03 - 0.99 = 0.04
CH <sub>4</sub>	...	...	
N <sub>2</sub> O	...	...	

An example of how to calculate the emissions for scope 2 and scope 3 in, for example, the residential sector under stationary energy:

Example data:

1,000 kWh is being consumed in the residential sector

Example emissions factors:

Electricity without losses: 0.99 kg CO<sub>2</sub>/kWh

Electricity losses: 0.04 kg CO<sub>2</sub>/kWh

Therefore the emissions in the residential sector would be:

Scope 1: 1,000 kWh x 0.99 kg CO<sub>2</sub>/kWh = 990 kg CO<sub>2</sub>

Scope 2: 1,000 kWh x 0.04 kg CO<sub>2</sub>/kWh = 40 kg CO<sub>2</sub>

## Liquid Fuel

### Liquid fuel sales data

Sourcing liquid fuel data

1. Go to the national Department of Energy (DoE) website <http://www.energy.gov.za/>
2. Click on “Statistics” (on the bottom left of their home page)
3. Click on “Fuel sales volume (Consumption)”
4. Click on / download the data of interest

The disaggregated data has fuel sales disaggregated by magisterial district (local level sales).

DoE provides data on a quarter-by-quarter basis. If you are interested in a financial year, e.g. 2014/15, you would need to download the 2014 and 2015 disaggregated data and extract the quarter 3 and quarter 4 data for 2014 and the quarter 1 and quarter 2 data for 2015.

FYI: All data are supplied in litres, i.e. litres of petrol, litres of LPG, etc.

### Assigning liquid fuel sales to municipality

DoE liquid fuel sales data are provided by magisterial district rather than by municipality. Sustainable Energy Africa can provide pdf maps of the magisterial district and municipal boundaries, as released in 2011. Unfortunately:

- More recent magisterial boundary maps cannot be found on the Municipal Demarcation Board website (<http://www.demarcation.org.za/>), which only has ward and municipal boundary maps.
- All indications are that magisterial district boundaries have changed. The Department of Justice and Constitutional Development (DJCD) released a statement that as from 1 December 2014, the magisterial districts in the country will be changed to ensure that they align with municipal boundaries; starting with the Gauteng and North West provinces. See more at: <http://www.justice.gov.za/maps/maps.html#sthash.RfHmcguN.dpuf>.
- Further indications are that DoE has not updated its magisterial district list according to the new magisterial districts as listed on the DJCD website (the names of the magisterial districts do not cross the two websites)

### Assigning liquid fuel sales to sector

DoE’s website publicly provides liquid fuel sales by *fuel* by *magisterial district*. A further level of data detail (liquid fuel sales by fuel by magisterial district by *trade category*) can be requested from DoE. This expanded dataset may also include other emissions-producing substances, e.g. solvents, oil, paraffin wax, grease, asphalt, etc. A Non-Disclosure Agreement may need to be signed.

The name of the trade category may sometimes give an indication as to the sector where the fuel is consumed. As an example of the trade category names given and how you’d use it to assign the fuel sales to a GPC sector, see the table below.

Fuel	Trade category	Suggested sector where you would assign this fuel
Aviation	Commercial	All aviation fuels can be assigned to II.4 Aviation. FYI: Aviation = Jet Fuel (used in large, commercial aircraft).
Aviation	General dealers	
Aviation	Military	
Aviation	Public Transport (non local Authority)	
Aviation	Remainder of general trade	
Aviation	Undefined (legacy data)	
Aviation Gasoline	Commercial	All aviation fuels can be assigned to II.4 Aviation. Aviation gasoline is used in smaller (usually private) aircraft.
Aviation Gasoline	Remainder of general trade	
Diesel	Agricultural Co-ops	Unclear whether used in II. Transportation (tractors, goods transport trucks, etc.) or stationary energy I.5 Agriculture,



Fuel	Trade category	Suggested sector where you would assign this fuel
Diesel	Farmers	Forestry and Fishing Activities (generators, farm machinery, etc.). Assign to II.1 On-Road Transportation until better information becomes available.
Diesel	Commercial	Unclear whether used in II. Transportation (vehicles) or stationary energy I.2. Commercial and Institutional Buildings and Facilities (generators, etc.). Assign to II.1 On-Road Transportation until better information becomes available. If wanting to disaggregate between local government use and other use it is best to get local government figures from the local authority directly rather than rely on DoE figures.
Diesel	Government	
Diesel	Local authorities	
Diesel	Public Transport (local Authority)	Assign to II.1 On-Road Transportation. To disaggregate between local government use and other use it is best to get local government figures from the local authority directly rather than rely on DoE figures.
Diesel	Construction	Unclear whether used in II. Transportation (trucks, earth-moving vehicles, etc.) or stationary energy I.3. Manufacturing Industries and Construction (non-mobile machinery, etc.). Assign to II.1 On-Road Transportation until better information becomes available.
Diesel	Mining	
Diesel	Road Haulage	Assign to II.1 On-Road Transportation. A line item can be added under this sub-sector, where this fuel usage can be reported under "Freight"
Diesel	Transnet	
Diesel	Public Transport (non local Authority)	Assign to II.1 On-Road Transportation.
Diesel	General dealers	
Diesel	Remainder of general trade	
Diesel	Retail - garages	
Diesel	Undefined (legacy data)	
Diesel		
Furnace Oil	Commercial	Furnace oil is usually used in boilers. Assign to I.2. Commercial and Institutional Buildings and Facilities.
Furnace Oil	Government	
Furnace Oil	General dealers	Furnace oil is usually used in boilers. Uncertainty on whether these trade categories refer to commercial & institutional sector or manufacturing sector (both use boilers). Assign to I.2. Commercial and Institutional Buildings and Facilities or I.3. Manufacturing Industries and Construction.
Furnace Oil	Remainder of general trade	
Furnace Oil	Construction	Assign to I.3. Manufacturing Industries and Construction
Furnace Oil	Road Haulage	Furnace oil cannot be used in road vehicles, but it is used in boilers (Stationary Energy) or railroad steam locomotives (Transportation). Check whether steam locomotives operate in the area. If yes, assign to II.2 Railways. If no, assign to I.2. Commercial and Institutional Buildings and Facilities (assuming fuel oil used in boilers for commercial purposes).
LPG	Commercial	Assign to I.2. Commercial and Institutional Buildings and Facilities
LPG	General dealers	Uncertainty over whether this fuel use goes to commercial, industrial or residential sector. Assign to I.1. Residential Buildings or I.2. Commercial and Institutional Buildings and
LPG	Independent LPG	

Fuel	Trade category	Suggested sector where you would assign this fuel
	Marketers	Facilities or I.3. Manufacturing Industries and Construction.
Paraffin	Agricultural Co-ops	Assign to I.5. Agriculture, Forestry and Fishing Activities
Paraffin	Farmers	
Paraffin	Commercial	Assign to I.2. Commercial and Institutional Buildings and Facilities
Paraffin	Government	
Paraffin	Construction	Assign to I.3. Manufacturing Industries and Construction
Paraffin	Mining	
Paraffin	General dealers	Sector unclear. Assign to I.1. Residential Buildings or I.2. Commercial and Institutional Buildings and Facilities or I.3. Manufacturing Industries and Construction.
Paraffin	Remainder of general trade	
Paraffin	Retail - garages	
Paraffin	Undefined (legacy data)	
Petrol	Agricultural Co-ops	Petrol is used largely in vehicles and sometimes in internal combustion engines in the industrial sector. Assign to II.1. On-Road Transportation unless better data is available that indicates otherwise.
Petrol	Farmers	
Petrol	Commercial	
Petrol	Construction	
Petrol	General dealers	
Petrol	Mining	
Petrol	Public Transport (non local Authority)	
Petrol	Remainder of general trade	
Petrol	Retail - garages	
Petrol	Undefined (legacy data)	
Petrol	Government	If wanting to disaggregate between local government use and other use, it is best to get local government figures from the local authority directly rather than rely on DoE figures.
Petrol	Road Haulage	A line item can be added under this sub-sector, where this fuel usage can be reported under "Freight"

Sales by trade category data may only be available for calendar year, but the City should try to request data by quarter if they wish to report by financial year. Alternatively a methodological decision could be taken whereby the 2014 calendar year will be used for the 2014/2015 financial year, the 2015 calendar year will be used for the 2015/16 financial year, etc. As long as the methodology is noted and remains consistent.

If the City is not able to obtain recent liquid fuel sales by trade category data, they may wish to use the 2013 trade category split in order to allocate 2014/15 data. The table below indicates the trade category split for 2013 calendar year liquid fuel sales for the magisterial districts that fall within Tshwane (i.e. Bronkhorstspuit, Cullinan, Pretoria, Soshanguve, Wonderboom). Note the additional products listed that are not available publically on DoE's website.

Product	Trade Category / Categories	GPC sector(s)	GPC sector (%)
Asphalt	Any	IV.2. Product Use	100%
Automotive Oil	Any	IV.2. Product Use	100%



Product	Trade Category / Categories	GPC sector(s)	GPC sector (%)
Aviation (Jet Fuel)	Any	II.4 Aviation	100%
Aviation Gasoline	Any	II.4 Aviation	100%
Diesel	Any	II.1. On-Road Transportation	100%
Furnace Oil	Remainder of general trade	I.2. Commercial and Institutional Buildings and Facilities <b>OR</b> I.3. Manufacturing Industries and Construction	100%
Grease	Any	IV.2. Product Use	100%
Industrial Oil	Any	IV.2. Product Use	100%
LPG	Commercial	I.2. Commercial and Institutional Buildings and Facilities	51%
LPG	General dealers; Remainder of general trade; Retail - garages	I.1. Residential Buildings <b>OR</b> I.2. Commercial and Institutional Buildings and Facilities	49%
LPG (total)			100%
Paraffin	Agricultural Co-ops	I.5. Agriculture, Forestry and Fishing Activities	27%
Paraffin	General dealers; Remainder of general trade; Retail - garages	I.1. Residential Buildings <b>OR</b> I.2. Commercial and Institutional Buildings and Facilities	73%
Paraffin (total)			100%
Paraffin Wax	Any	IV.2. Product Use	100%
Petrol	Any	II.1. On-Road Transportation	100%
Process Oil	Any	IV.2. Product Use	100%
Solvents	Any	IV.2. Product Use	100%

In the case where there are two options (indicated by an **OR**), a methodological decision would need to be made as to which GPC sector this product would be allocated. This allocation can be based on data from local studies (if available) or it can be decided to assign all of the product to the one sector with a notation of IE (Included Elsewhere) in the other sector, noting that the data could not be disaggregated.

## Coal and Wood

It is incredibly difficult to source coal and wood supply (i.e. sales) data, therefore the City may decide to estimate coal and wood use, using a demand (bottom-up) approach.

### Residential sector coal and wood consumption

The amount of coal or wood used in the residential sector can be calculated, using a bottom-up approach, as follows:

Estimated amount of fuel (e.g. coal, wood, etc.) used per household per end use (cooking, heating, etc.) x number of households that use this fuel = amount of this fuel used in the residential sector

StatsSA's Census 2011 provides information on the number of households in a municipality using coal or wood for space heating or cooking. There are more recent StatsSA surveys (i.e. the General Household Surveys), but these do not provide data at a municipal level, only at a provincial level, which is why the Census 2011 data is used.

The StatsSA data can be drawn from their website, using their interactive tool.

1. Go to StatsSA's website: <http://www.statssa.gov.za/>
2. At the bottom of the home page, click on "SuperWEB2" ( it is under "Tools")
3. Log in as a guest by clicking on the "Guest" button
4. In the list of folders shown on the left, click on the arrow next to "Community Profiles." This will cause sub-level folders to be shown.
5. Click on the arrow next to "Census 2011"
6. Click on the arrow next to "Household Services." Now, rather than a folder, a grey icon will appear.
7. Double-click on the grey icon next to "Household Services." The whole page will update and you will now see only one folder: Household Services\_wd

From this page, you will now be able to draw data on household services, e.g. waste services, sanitation services, electricity services, types of energy used and what it is used for, etc.

8. Click once on the folder next to "Household Services"
9. Click on the "Geography" folder
10. Click on the "Gauteng" folder
11. Click the tick-box next to "TSH: City of Tshwane." Given that you have now selected something, the 4 blue boxes at the top left of the web page (Row, Column, Filter, Wafer) becomes active.
12. Click the "Filter" blue button at the top left of the web page.

You have now applied "TSH: City of Tshwane" as a filter, which means that all data drawn will be for the City of Tshwane only (the default is to draw national data). You can see that the filter has appeared in the middle of the web page (it will show as "X Geography: TSH: City of Tshwane"), where the data table will appear when you collate data. If you want to remove the filter at any time, you can click the X next to it (not recommended, as then national-level data will show rather than data for Tshwane).

As an example, you will now draw data on the number of households using coal or wood as their main fuel for cooking.

13. Click on the folder next to "Energy or fuel for cooking." A list of check-boxes will now appear below this folder.
14. Click the "Coal" and "Wood" check-boxes.
15. Click on the "Row" or "Column" blue button on the top left of the page. An empty table will now display in the centre of the page.

16. Click on the "Retrieve Data" button (it looks like a Play button). Your table will now be populated with data.
17. You can export the data in a spreadsheet. In the top right of the web page there is a "Download Table" option. Click the "Go" button to download the data as an Excel spreadsheet.

In this example, the output would be as follows:

Main fuel used for cooking (StatsSA Census 2011)	No. of households
Wood	9,628
Coal	1,473

18. Do the same to draw the wood and coal use data for space heating. Tip: Rather than starting all over again, you do one of two things:
  - a. Clear the table completely by clicking on the "Clear Table" button (it has a big cross on it). You will then have to re-select your "TSH: City of Tshwane" filter before drawing your data on space heating.
  - b. Only remove the cooking data. Do this by hovering over the "Energy or fuel for cooking" in the table. Your cursor will turn into a cross with 4 arrows. Click and hold on this heading, while dragging the heading into the Trash folder (it has a dustbin icon). This will remove only the cooking data, but leave the Tshwane filter. Now you only need to draw the space heating data and do not need to re-select the Tshwane filter.

You now have the number of households using either coal or wood for either space heating or cooking.

There are some studies and analyses available on the estimated amount of wood or coal used for space heating or cooking per household per annum. Try to find local and recent studies on Tshwane households' energy use characteristics. Alternatively, the following figures can be used:

2011/12 estimate of amount of wood used per household in Gauteng	kg/ day	kg/ year
Using wood as main fuel for cooking	5.6	2,044
Using wood as main fuel for heating	1.2	438
<b>Source</b>		
Hughes A. 2015. "Bottom-up Model of Residential Wood-Use for 1996, 2006 and 2011", Excel spreadsheet, Energy Research Centre, University of Cape Town, Source model for DEA (2015), "Survey on economy-wide fuel consumption with emphasis on demand-side sectors"		
<b>Notes</b>		
Though this is a 2011/12 estimate, these figures are probably not changing very quickly given that the socio-economic circumstances for fuelwood users are not changing much, although fuelwood is becoming more scarce and households are buying more so commercial fuels competition is increasing		

2011/12 estimate of amount of coal used per household in Gauteng	kg/ year
Using coal as main fuel for cooking	1,014
Using coal as main fuel for heating	973

Source
ERC (2013), "South African TIMES Model (SATIM) Methodology", <a href="http://www.erc.uct.ac.za/groups/esap/satim">http://www.erc.uct.ac.za/groups/esap/satim</a>

19. Use the amount of coal or wood used for space heating or cooking per household per year and the number of households using wood or coal for space heating or cooking to estimate the amount of wood or coal used in the residential sector. As an example:

End use	No. of households using wood (A)	kg wood used per household per annum (B)	kg wood used in residential sector (A x B)
Cooking	9,628	2,044	19,679,632
Space heating	38,996	438	17,080,248
<b>TOTAL</b>			<b>36,759,880</b>

### Commercial and industrial coal and wood use

Customers burning large amounts of fuel may require a licence (whether from a local, provincial or national authority) to operate and may have to report on the amounts of these fuels burned. If this is the case, try to source this data from the relevant authority. If customer privacy is a concern, amalgamated data can be requested, i.e. estimated coal used in the industrial sector, etc.

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