THE GLOBAL PROTOCOL FOR COMMUNITY-SCALE GREENHOUSE GAS EMISSION INVENTORIES (GPC)

A city's ability to take effective action on mitigating climate change, and monitor progress, depends on having access to good quality data on greenhouse gas (GHG) emissions. Planning for climate action begins with measuring GHG emissions.

A city-wide GHG inventory enables cities to measure their overall emissions, as well as understand the contribution of different activities within the city. In 2014, C40, WRI and ICLEI launched the Global Protocol for Community-scale Greenhouse Gas Emission Inventories (GPC) to support cities to develop robust, comprehensive and consistent inventories. It seeks to:

> Help cities develop a comprehensive and robust GHG inventory in order to support climate action planning
> Help cities establish a base year emissions inventory, set reduction targets, and track their performance
> Ensure consistent and transparent measurement and reporting of GHG emissions between cities, following internationally recognized GHG accounting and reporting principles
> Enable city inventories to be aggregated at subnational and national levels
> Demonstrate the important role that cities play in tackling climate change, and facilitate insight through benchmarking—and aggregation—of comparable data.

GPC REPORTING FRAMEWORK (GPC CHAPTER 4.1, FIGURE 4.1, PAGE 37)

The GPC does not specify the calculation methodologies to be used to estimate your city's emissions. Rather, it provides a clear framework for calculating and reporting city-wide GHG emissions, consistent with IPCC Guidelines, that emphasises transparency and organisation of emissions data in a way that facilitates consistency and comparability across cities globally.

The GPC requires cities to report GHG emissions by scope and sector. Activities taking place within a city can generate GHG emissions that occur inside the city boundary as well as outside the city boundary. To distinguish between these, the GPC groups emissions into three categories based on where they occur in order to avoid double counting: scope 1, scope 2 or scope 3.

Scope	Definition
Scope 1	GHG emissions from sources located within the city boundary.
Scope 2	GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the city boundary.
Scope 3	All other GHG emissions that occur outside the city boundary as a result of activities taking places within the city boundary.

The GPC distinguishes between emissions that physically occur within the city (scope 1), from those that occur outside the city but are driven by activities taking place within the city's boundaries (scope 3), from those that occur from the use of electricity, steam, and/or heating/cooling supplied by grids which may or may not cross city boundaries (scope 2).

The sectors and sub-sectors that the GPC requires a city to report are shown in the table on the right, and definitions are provided in the section below.

The GPC uses two distinct but complementary approaches to adding up and reporting emissions:

> The city-induced framework measures GHG emissions attributable to activities taking place within the geographic boundary of the city. This covers selected scope 1, 2 and 3 emission sources, and provides two reporting levels. The BASIC level covers emission sources that occur in almost all cities (Stationary Energy, in-boundary transportation, and in-boundary generated waste) and the calculation methodologies and data are more readily available. The BASIC+ level has a more comprehensive coverage of emissions sources (BASIC sources plus IPPU, AFOLU, transboundary transportation, and energy transmission and distribution losses) and reflects more challenging data collection and calculation procedures.

> The scopes framework allows cities to comprehensively report all GHG emissions attributable to activities taking place within the geographic boundary of the city by categorizing the emission sources into in-boundary sources (scope 1, or "territorial"), grid-supplied energy sources (scope 2), and out-of-boundary sources (scope 3). Scope 1 allows for a territorial approach to aggregating multiple cities' inventories, consistent with national-level GHG reporting.

Sectors and sub-sectors	Scope 1	Scope 2	Scope 3
Stationary energy			
Residential buildings	✔	✔	✔
Commercial buildings	✔	✔	✔
Institutional buildings	✔	✔	✔
Manufacturing industries and construction	✔	✔	✔
Energy industries	✔	✔	✔
Energy generation supplied to the grid	✔		
Agriculture, forestry, and fishing activities	✔	✔	✔
Non-specified sources	✔	✔	✔
Fugitive emissions from coal	✔		
Fugitive emissions from oil and natural gas systems	✔		
Transportaton			
On-road	✔	✔	✔
Railways	✔	✔	✔
Waterborne navigation	✔	✔	✔
Aviation	✔	✔	✔
Off-road	✔	✔	
Waste			
Solid waste generated in the city	✔		✔
Solid waste generated outside the city	✔		
Biological waste generated in the city	✔		✔
Biological waste generated outside the city	✔		
Incinerated and burned waste generated in the city	✔		✔
Incinerated and burned waste generated outside city	✔		
Wastewater generated in the city	✔		✔
Wastewater generated outside the city	✔		
Industrial processes and product use (IPPU)			
Industrial processes	✔		
Product use	✔		
Agriculture, forestry, and fishing activities (AFOLU)			
Livestock	✔		
Land	✔		
Other agriculture	✔		
Other scope 3			

✔ = sources required for reporting
✔ = sources required for BASIC reporting
✔ + ✔ = sources required for BASIC+ reporting
✔ = additional scope 1 sources required for territorial reporting
= other scope 3 sources
= non-applicable emission sources

SECTOR DEFINITIONS

The table below provides definitions of all the sectors and sub-sectors covered by the GPC:

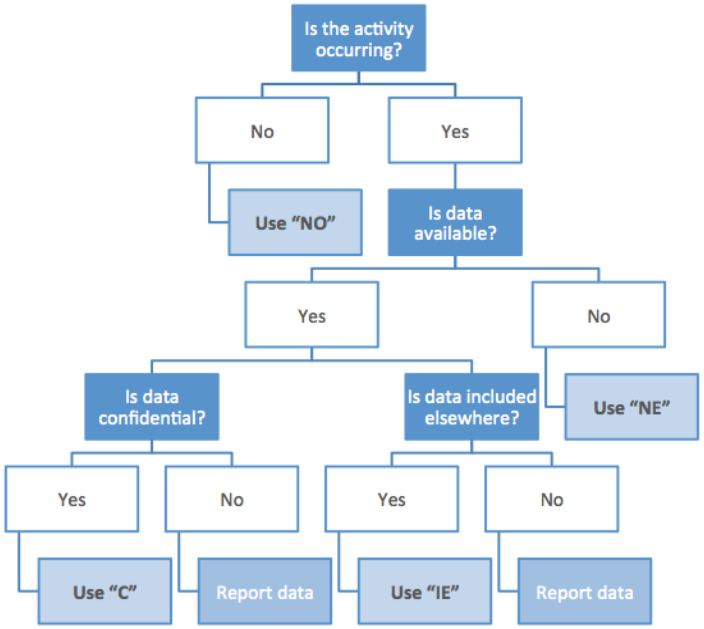
Sectors and sub-sectors	Definition
Stationary energy	GHG emissions come from fuel combustion, as well as fugitive emissions released in the process of generating, delivering, and consuming useful forms of energy (such as electricity or heat).
Residential buildings	All emissions from energy use in households
Commercial buildings	All emissions from energy use in commercial buildings and facilities
Institutional buildings	All emissions from energy use in public buildings such as schools, hospitals, government offices, highway street lighting, and other public facilities
Manufacturing industries and construction	All emissions from energy use in industrial facilities and construction activities, except those included in energy industries sub-sector. This also includes combustion for the generation of electricity and heat for own use in these industries
Energy industries	All emissions from energy production and use in energy industries
Energy generation supplied to the grid	All emissions from the generation of energy for grid-distributed electricity, steam, heat and cooling
Agriculture, forestry, and fishing activities	All emissions from energy use in agriculture, forestry, and fishing activities
Non-specified sources	All remaining emissions from facilities producing or consuming energy not specified elsewhere
Fugitive emissions from mining, processing, storage, and transportation of coal	Includes all intentional and unintentional emissions from the extraction, processing, storage and transport of fuel in the city
Fugitive emissions from oil and natural gas systems	Fugitive emissions from all oil and natural gas activities occurring in the city. The primary sources of these emissions may include fugitive equipment leaks, evaporation losses, venting, flaring and accidental releases.
Transportation	City transportation systems are designed to move people and goods within and beyond city borders. Transport vehicles and mobile equipment or machinery produce GHG emissions directly by combusting fuel or indirectly by consuming grid-delivered electricity.
On-road	On-road vehicles are designed for transporting people, property or material on common or public roads, thoroughfares, or highways. This category includes vehicles such as buses, cars, taxis, trucks, motorcycles, on-road waste collection and transportation vehicles (e.g. compactor trucks), etc.
Railways	Railways typically use energy through combustion of diesel fuels or electricity. Railways can be divided into four sub-categories: urban railway subway systems inc. trams, regional commuter rail national rail and international rail. Each can be further classified as passenger or freight.
Waterborne navigation	Water transportation includes ships, ferries, and other boats operating within the city boundary, as well as marine-vessels whose journeys originate or end at ports within the city's boundary but travel to destinations outside of the city.
Aviation	Civil aviation, or air travel, includes emissions from airborne trips occurring within the geographic boundary (e.g., helicopters operating within the city) and emissions from flights departing airports that serve the city
Off-road	Off-road vehicles are those designed or adapted for travel on unpaved terrain. This category typically includes airport ground support equipment, all-terrain vehicles, landscaping and construction equipment, bulldozers, forklifts, snowmobiles etc.
Waste	Waste disposal and treatment produces GHG emissions through aerobic or anaerobic decomposition, or incineration.
Solid waste generated in the city	Solid waste may be disposed of at managed sites (e.g., sanitary landfill and managed dumps), and at unmanaged disposal sites (e.g., open dumps, including above-ground piles, holes in the ground, and dumping into natural features, such as ravines)
Biological waste generated in the city	The biological treatment of waste refers to composting and anaerobic digestion of organic waste, such as food waste, garden and park waste, sludge, and other organic waste sources.
Incinerated and burned waste generated in the city	Incineration is a controlled, industrial process, often with energy recovery where inputs and emissions can be measured and data is often available. By contrast, open burning is an uncontrolled, often illicit process with different emissions and can typically only be estimated based on collection rates.
Wastewater generated in the city	Wastewater can be treated aerobically (in presence of oxygen) or anaerobically (in absence of oxygen). Wastewater can generally be categorized as domestic wastewater or industrial wastewater, and cities must report emissions from both.
Industrial processes and product use	GHG emissions resulting from non-energy related industrial activities and product uses. All GHG emissions occurring from industrial processes, product use, and non-energy uses of fossil fuel, shall be reported under IPPU.
Industrial processes	GHG emissions are produced from a wide variety of industrial activities. The main emission sources are releases from industrial processes that chemically or physically transform materials. Note, if fuels are combusted for energy use, the emission shall be reported under Stationary Energy.
Product use	Products such as refrigerants, foams or aerosol cans can release potent GHG emissions
Agriculture, forestry, and fishing activities	GHG emissions are produced through a variety of pathways, including land-use change that alter the composition of the soil, methane produced in the digestive processes of livestock, and nutrient management for agricultural purposes.
Livestock	Livestock production emits CH4 through enteric fermentation, and both CH4 and N2O through management of their manure.
Land	Emissions and removals of CO2 are based on changes in ecosystem C stocks and are estimated for each land-use category. C stocks consist of above-ground and below-ground biomass, dead organic matter, and soil organic matter.
Other agriculture	Other sources of GHG emissions from land include rice cultivation, fertilizer use, liming, and urea application.
Other scope 3	Cities may optionally report other scope 3 emissions, such as GHG emissions embodied in fuels, water, food and construction materials.

NOTATION KEYS (GPC CHAPTER 2.2, PAGE 26)

To accommodate limitations in data availability and differences in emission sources between cities, the GPC requires the use of notation keys, as recommended in IPCC Guidelines. Where notation keys are used, cities need to provide an accompanying explanation to justify exclusions or partial accounting of GHG emission source categories.

When collecting emissions data, the first step is identifying whether or not an activity occurs in a city. If it does not, the notation key "NO" is used for the relevant GHG emission source category. For example, a landlocked city with no transport by water would use the notation key "NO" to indicate that GHG emissions from water transport do not occur. If the activity does occur in the city – and data are available – then the emissions should be reported. However, if the data are also included in another emissions source category or cannot be disaggregated, the notation key "IE" shall be used with appropriate explanation in order to avoid double counting, and the category in which they are included should be identified. For example, emissions from waste incineration would use "IE" if these emissions were also reported under generation of energy for use in buildings. If the data are available but cannot be reported for reasons of data confidentiality and cannot be included in another emissions source category, the notation key “C” would be used. For instance, certain military operations or industrial facilities may not permit public data disclosure where this impacts security. Finally, if the data are not available and, therefore, the emissions are not estimated, the notation key "NE" would be used. The latter should be avoided and can not be used for BASIC sources.

When to use notation keys?



Definitions

Notation key		Description and examples
Not occurring	NO	An activity or process does not occur or exist within the city.
	Example	I.7.1 does not occur. No coal-related activities within the city boundary.
		II.2.2 does not occur. Number of electric vehicles is negligible compared to total vehicle fleet (0.01% of vehicle sales in 2014 were electric).
Included elsewhere	IE	GHG emissions for this activity are estimated and presented in another category of the inventory. That category shall be noted in the explanation.
	Example	II.5.1 is reported in II.1.1. Fuel sales approach does not allow for disaggregation.
		III.1.2 is reported in I Stationary. Landfill gas is captured and burned as an energy source.
Not estimated	NE	Emissions occur but have not been estimated or reported; justification for exclusion shall be noted in the explanation
	Example	III.4.3 has not been estimated. Activity not required for BASIC inventory.
		V.1 has not been estimated. No livestock data available.
Confidential	C	GHG emissions which could lead to the disclosure of confidential information and can therefore not be reported.
	Example	Activity data for IV.1 is confidential. Data cannot be aggregated to provide confidentiality.
		II.5.1 is confidential. Military base within city boundary.

GLOBAL WARMING POTENTIAL (GPC CHAPTER 5.5, TABLE 5.2, PAGE 51)

CO2 equivalents (CO2e) is a universal unit of measurement that accounts for the global warming potential (GWP) when measuring and comparing GHG emissions from different gases. Individual GHGs should be converted into CO2e by multiplying by the 100-year GWP coefficients in the latest version of the IPCC Guidelines or the version used by the country's national inventory body.

Greenhouse gas		IPCC Assessment Report			
Formula	Name	5AR	4AR	3AR	2AR
CO2	Carbon Dioxide	1	1	1	1
CH4	Methane	28	25	23	21
N2O	Nitrous Oxide	265	298	296	310
SF6	Sulphur hexafluoride	23,500	22,800	22,200	23,900
CF4	Carbon tetrafluoride	6,630	7,390	5,700	6,500
C2F6	Hexafluoroethane	11,100	12,200	11,900	9,200
CHF3	HFC-23	12,400	14,800	12,000	11,700
CH2F2	HFC-32	677	675	550	650
CH3F	HFC-41	116	92	97	150
C2HF5	HFC-125	3,170	3,500	3,400	2,800
C2H2F4	HFC-134	1,120	1,100	1,100	1,000
CH2FCF3	HFC-134a	1,300	1,430	1,300	1,300
C2H3F3	HFC-143	328	353	330	300
C2H4F3	HFC-143a	4,800	4,470	4,300	3,800
C2H4F2	HFC-152a	138	124	120	140
C3HF7	HFC-227ea	3,350	3,220	3,500	2,900
C3H2F6	HFC-236fa	8,060	9,810	9,400	6,300
C3H3F5	HFC-245ca	716	1,030	950	560
NF3	Nitrogen trifluoride	16,100	17,200		

Full references to the IPCC Assessment Reports are provided in the GPC

CIRIS	Introduction	Set-up	Inventory	Calculators	Results	Notes
	User guide	GPC	Notation keys	GWP	Conversion factors	

CONVERSION FACTORS

Conversion factors are embedded in the activity data multiplier function in the Inventory sheets. The tables below show the conversion factors for commonly used units for energy, mass, volume and distance.

Conversion factors for SI prefixes

To	T	G	M	k
Multiply by:				
Tera (T) - 1000000000000 - 10^{12}	1	1000	1000000	1000000000
Giga (G) - 1000000000 - 10^{9}	0.001	1	1000	1000000
Mega (M) - 1000000 - 10^{6}	0.000001	0.001	1	1000
Kilo (k) - 1000 - 10^{3}	0.000000001	0.000001	0.001	1

General conversion factors for mass

To	g	kg	t	lt	st	lb
Multiply by:						
gramme (g)	1	0.001	0.000001	0.000000984	0.000001102	0.0022046
Kilogramme (	1000	1	0.001	0.000984	0.001102	2.2046
Metric tonne (	1000000	1000	1	0.984	1.1023	2204.6
Long ton (lt)	1016000	1016	1.016	1	1.12	2240
Short ton (st)	907200	907.2	0.9072	0.893	1	2000
Pound (lb)	453.5970244	0.453597024	0.000453597	0.000446429	0.0005	1

General conversion factors for volume

To	l	m3	ft3	bbl	UK gal	US gal
Multiply by:						
Litre (l)	1	0.001	0.0353	0.0063	0.22	0.264200793
Cubic metre (m3)	1000	1	35.3	6.3	220	264.2007926
Cubic foot (ft3)	28.3	0.0283	1	0.1781	6.229	7.48
Barrel (bbl)	159	0.159	5.615	1	34.97	42
UK gallon (gal)	4.546	0.0045	0.1605	0.02859	1	1.201
US gallon (gal)	3.785	0.0038	0.1337	0.02381	0.8327	1

General conversion factors for distance

To	mile	km	m	feet	inch	cm
Multiply by:						
mile	1	1.609	1609.344	5280	63360	160934.4
kilometre (km)	0.621	1	1000	3280.840	39370.079	100000
meter (m)	0.000621371	0.001	1	3.281	39.370	100
feet	0.000189	0.000305	0.305	1	12	30.48
inch	1.58E-05	2.54E-05	0.0254	0.083	1	2.54
centimetre (cm)	6.21E-06	0.00001	0.01	0.0328	0.394	1

General conversion factors for energy

To		kWh	MWh	GWh	TWh	MJ	GJ	TJ	Mcal	Gcal	Btu	kBtu	MMBtu	Therm	Mtoe	BOE
Multiply by:																
Kilowatt hour	kWh	1	0.001	0.000001	0.000000001	4	0.0036	0.0000036	0.860420652	0.000860421	3412.141635	3.412141635	0.003412142	0.034095106	8.59845E-11	0.000614175
Megawatt ho	MWh	1000	1	0.001	0.000001	3600	3.6	0.0036	860.4206517	0.860420652	3412141.635	3412.141635	3.412141635	34.09510641	8.59845E-08	0.614175163
Gigawatt hou	GWh	1000000	1000	1	0.001	3600000	3600	3.6	860420.6517	860.4206517	3412141635	3412141.635	3412.141635	34095.10641	8.59845E-05	614.1751628
Terawatt hou	TWh	1000000000	1000000	1000	1	3600000000	3600000	3600	860420651.7	860420.6517	3.41214E+12	3412141635	3412141.635	34095106.41	0.085984523	614175.1628
Megajoules	MJ	0.277777778	0.000277778	2.77778E-07	2.77778E-10	1	0.001000	0.000001	0.239005737	0.000239006	947.8171209	0.947817121	0.000947817	0.009470863	2.38846E-11	0.000170604
Gigajoules	GJ	277.7777778	0.277777778	0.000277778	2.77778E-07	1000	1	0.00100	239.0057366	0.239005737	947817.1209	947.8171209	0.947817121	9.47086289	2.38846E-08	0.170604212
Terajoules	TJ	277777.7778	277.7777778	0.277777778	0.000277778	1000000	1000	1	239005.7366	239.0057366	947817120.9	947817.1209	947.8171209	9470.86289	2.38846E-05	170.6042119
Mega calorie	Mcal	1.16222222	0.001162222	1.16222E-06	1.16222E-09	4.183999992	0.004184	4.184E-06	1	0.001	3965.666826	3.965666826	0.003965667	0.03962609	9.99331E-11	0.000713808
Giga calories	Gcal	1162.22222	1.16222222	0.001162222	1.16222E-06	4183.999992	4.183999992	0.004184	1000	1	3965666.826	3965.666826	3.965666826	39.62609026	9.99331E-08	0.713808021
British therma	Btu	0.000293071	2.93071E-07	2.93071E-10	2.93071E-13	0.001055056	1.05506E-06	1.05506E-09	0.000252164	2.52164E-07	1	0.001	0.000001	9.99229E-06	2.51996E-14	1.79997E-07
Kilo Btu	kBtu	0.29307107	0.000293071	2.93071E-07	2.93071E-10	1.055055852	0.001055056	1.05506E-06	0.252164401	0.000252164	1000	1	0.001	0.009992289	2.51996E-11	0.000179997
Million Btu	MMBtu	293.07107	0.29307107	0.000293071	2.93071E-07	1055.055852	1.055055852	0.001055056	252.1644011	0.252164401	1000000	1000	1	9.992289316	2.51996E-08	0.179996972
Therms	Therm	29.32972222	0.029329722	2.93297E-05	2.93297E-08	105.587	0.105587	0.000105587	25.23589871	0.025235899	100077.1663	100.0771663	0.100077166	1	2.5219E-09	0.018013587
Million tonne	Mtoe	11630000000	11630000	11630	11.63	41868000000	41868000	41868	10006692180	10006692.18	3.96832E+13	39683207217	39683207.22	396526087.5	1	7142857.143
Barrels of oil e	BOE	1628.2	1.6282	0.0016282	1.6282E-06	5861.52	5.86152	0.00586152	1400.936905	1.400936905	5555649.01	5555.64901	5.55564901	55.51365225	0.00000014	1

Fuel volume to energy conversion factors

	From	To	Factor
Aviation gasoline	m³	kWh	9290.544485
Aviation gasoline	m³	MWh	9.290512785
Aviation gasoline	m³	GWh	0.009290513
Aviation gasoline	m³	TWh	9.29051E-06
Aviation gasoline	m³	MJ	33446.09963
Aviation gasoline	m³	GJ	33.44609963
Aviation gasoline	m³	TJ	0.0334461
Aviation gasoline	m³	Mcal	7988.439826
Aviation gasoline	m³	Gcal	7.988439826
Aviation gasoline	m³	Btu	31700661.22
Aviation gasoline	m³	kBtu	31700.66122
Aviation gasoline	m³	MMBtu	31.70066122
Aviation gasoline	m³	Therm	317.0066122
Aviation gasoline	m³	Mtoe	7.98844E-07
Aviation gasoline	m³	BOE	5.466779028
Biodiesels	m³	kWh	9909.914118
Biodiesels	m³	MWh	9.909880304
Biodiesels	m³	GWh	0.00990988
Biodiesels	m³	TWh	9.90988E-06
Biodiesels	m³	MJ	35675.83961
Biodiesels	m³	GJ	35.67583961
Biodiesels	m³	TJ	0.03567584
Biodiesels	m³	Mcal	8521.002481
Biodiesels	m³	Gcal	8.521002481
Biodiesels	m³	Btu	33814038.64
Biodiesels	m³	kBtu	33814.03864
Biodiesels	m³	MMBtu	33.81403864
Biodiesels	m³	Therm	338.1403864
Biodiesels	m³	Mtoe	8.521E-07
Biodiesels	m³	BOE	5.831230963
Biogasoline	m³	kWh	8979.543509
Biogasoline	m³	MWh	8.979512869
Biogasoline	m³	GWh	0.008979513
Biogasoline	m³	TWh	8.97951E-06
Biogasoline	m³	MJ	32326.49144
Biogasoline	m³	GJ	32.32649144
Biogasoline	m³	TJ	0.032326491
Biogasoline	m³	Mcal	7721.026802
Biogasoline	m³	Gcal	7.721026802
Biogasoline	m³	Btu	30639481.59
Biogasoline	m³	kBtu	30639.48159
Biogasoline	m³	MMBtu	30.63948159
Biogasoline	m³	Therm	306.3948159
Biogasoline	m³	Mtoe	7.72103E-07
Biogasoline	m³	BOE	5.2837786
Bitumen	m³	kWh	26383.63655
Bitumen	m³	MWh	26.38354653
Bitumen	m³	GWh	0.026383547
Bitumen	m³	TWh	2.63835E-05
Bitumen	m³	MJ	94981.48769
Bitumen	m³	GJ	94.98148769
Bitumen	m³	TJ	0.094981488
Bitumen	m³	Mcal	22685.87092
Bitumen	m³	Gcal	22.68587092
Bitumen	m³	Btu	90024726.27
Bitumen	m³	kBtu	90024.72627
Bitumen	m³	MMBtu	90.02472627
Bitumen	m³	Therm	900.2472627
Bitumen	m³	Mtoe	2.26859E-06
Bitumen	m³	BOE	15.52476404
Butane	m³	kWh	7974.384017
Butane	m³	MWh	7.974356807
Butane	m³	GWh	0.007974357
Butane	m³	TWh	7.97436E-06
Butane	m³	MJ	28707.90218
Butane	m³	GJ	28.70790218
Butane	m³	TJ	0.028707902
Butane	m³	Mcal	6856.744184
Butane	m³	Gcal	6.856744184
Butane	m³	Btu	27209734.22
Butane	m³	kBtu	27209.73422
Butane	m³	MMBtu	27.20973422
Butane	m³	Therm	272.0973422
Butane	m³	Mtoe	6.85674E-07
Butane	m³	BOE	4.692318666
Charcoal	m³	kWh	2954.084903
Charcoal	m³	MWh	2.954074823
Charcoal	m³	GWh	0.002954075
Charcoal	m³	TWh	2.95407E-06
Charcoal	m³	MJ	10634.75
Charcoal	m³	GJ	10.63475
Charcoal	m³	TJ	0.01063475
Charcoal	m³	Mcal	2540.058822
Charcoal	m³	Gcal	2.540058822
Charcoal	m³	Btu	10079758.5
Charcoal	m³	kBtu	10079.7585
Charcoal	m³	MMBtu	10.0797585
Charcoal	m³	Therm	100.797585
Charcoal	m³	Mtoe	2.54006E-07
Charcoal	m³	BOE	1.738254353
Coal (Bituminous or Black coal)	m³	kWh	6722.248229
Coal (Bituminous or Black coal)	m³	MWh	6.722225292
Coal (Bituminous or Black coal)	m³	GWh	0.006722225
Coal (Bituminous or Black coal)	m³	TWh	6.72223E-06
Coal (Bituminous or Black coal)	m³	MJ	24200.19455
Coal (Bituminous or Black coal)	m³	GJ	24.20019455
Coal (Bituminous or Black coal)	m³	TJ	0.024200195
Coal (Bituminous or Black coal)	m³	Mcal	5780.099924
Coal (Bituminous or Black coal)	m³	Gcal	5.780099924
Coal (Bituminous or Black coal)	m³	Btu	22937268.54
Coal (Bituminous or Black coal)	m³	kBtu	22937.26854
Coal (Bituminous or Black coal)	m³	MMBtu	22.93726854
Coal (Bituminous or Black coal)	m³	Therm	229.3726854
Coal (Bituminous or Black coal)	m³	Mtoe	5.7801E-07
Coal (Bituminous or Black coal)	m³	BOE	3.95553196
Coke	m³	kWh	10499.95621
Coke	m³	MWh	10.49992038
Coke	m³	GWh	0.01049992
Coke	m³	TWh	1.04999E-05
Coke	m³	MJ	37800
Coke	m³	GJ	37.8
Coke	m³	TJ	0.0378
Coke	m³	Mcal	9028.347961
Coke	m³	Gcal	9.028347961
Coke	m³	Btu	35827346.31
Coke	m³	kBtu	35827.34631
Coke	m³	MMBtu	35.82734631
Coke	m³	Therm	358.2734631
Coke	m³	Mtoe	9.02835E-07
Coke	m³	BOE	6.178425872
Coking coal	m³	kWh	6673.809291
Coking coal	m³	MWh	6.673786519
Coking coal	m³	GWh	0.006673787
Coking coal	m³	TWh	6.67379E-06
Coking coal	m³	MJ	24025.81364
Coking coal	m³	GJ	24.02581364
Coking coal	m³	TJ	0.024025814
Coking coal	m³	Mcal	5738.449884
Coking coal	m³	Gcal	5.738449884
Coking coal	m³	Btu	22771987.99
Coking coal	m³	kBtu	22771.98799
Coking coal	m³	MMBtu	22.77198799
Coking coal	m³	Therm	227.7198799
Coking coal	m³	Mtoe	5.73845E-07
Coking coal	m³	BOE	3.927029328
Coal (manufactured solid fuels	m³	kWh	5756.160513
Coal (manufactured solid fuels	m³	MWh	5.756140873
Coal (manufactured solid fuels	m³	GWh	0.005756141
Coal (manufactured solid fuels	m³	TWh	5.75614E-06
Coal (manufactured solid fuels	m³	MJ	20722.26427
Coal (manufactured solid fuels	m³	GJ	20.72226427
Coal (manufactured solid fuels	m³	TJ	0.020722264
Coal (manufactured solid fuels	m³	Mcal	4949.413025
Coal (manufactured solid fuels	m³	Gcal	4.949413025
Coal (manufactured solid fuels	m³	Btu	19640839.64
Coal (manufactured solid fuels	m³	kBtu	19640.83964
Coal (manufactured solid fuels	m³	MMBtu	19.64083964
Coal (manufactured solid fuels	m³	Therm	196.4083964
Coal (manufactured solid fuels	m³	Mtoe	4.94941E-07
Coal (manufactured solid fuels	m³	BOE	3.387062796
Compressed Natural Gas (CNG	m³	kWh	10.63736888
Compressed Natural Gas (CNG	m³	MWh	0.010637369
Compressed Natural Gas (CNG	m³	GWh	1.06374E-05
Compressed Natural Gas (CNG	m³	TWh	1.06374E-08
Compressed Natural Gas (CNG	m³	MJ	38.29452798
Compressed Natural Gas (CNG	m³	GJ	0.038294528
Compressed Natural Gas (CNG	m³	TJ	3.82945E-05
Compressed Natural Gas (CNG	m³	Mcal	9.152611868
Compressed Natural Gas (CNG	m³	Gcal	0.009152612
Compressed Natural Gas (CNG	m³	Btu	36296.20926
Compressed Natural Gas (CNG	m³	kBtu	36.29620923
Compressed Natural Gas (CNG	m³	MMBtu	0.036268222
Compressed Natural Gas (CNG	m³	Therm	0.362682224
Compressed Natural Gas (CNG	m³	Mtoe	9.14649E-10
Compressed Natural Gas (CNG	m³	BOE	0.006533208
Crude oil	m³	kWh	10684.12616
Crude oil	m³	MWh	10.6840897
Crude oil	m³	GWh	0.01068409
Crude oil	m³	TWh	1.06841E-05
Crude oil	m³	MJ	38463.01457
Crude oil	m³	GJ	38.46301457
Crude oil	m³	TJ	0.038463015
Crude oil	m³	Mcal	9186.705799
Crude oil	m³	Gcal	9.186705799
Crude oil	m³	Btu	36455760.41
Crude oil	m³	kBtu	36455.76041
Crude oil	m³	MMBtu	36.45576041
Crude oil	m³	Therm	364.5576041
Crude oil	m³	Mtoe	9.18671E-07
Crude oil	m³	BOE	6.286795882
Diesel oil	m³	kWh	10692.37326
Diesel oil	m³	MWh	10.69237326
Diesel oil	m³	GWh	0.010692373
Diesel oil	m³	TWh	1.06924E-05
Diesel oil	m³	MJ	38492.54374
Diesel oil	m³	GJ	38.49254371
Diesel oil	m³	TJ	0.038492544
Diesel oil	m³	Mcal	9199.93877
Diesel oil	m³	Gcal	9.19993877
Diesel oil	m³	Btu	36483891.98
Diesel oil	m³	kBtu	36483.89196
Diesel oil	m³	MMBtu	36.45576041
Diesel oil	m³	Therm	364.5576041
Diesel oil	m³	Mtoe	9.19379E-07
Diesel oil	m³	BOE	6.566990088
E85	m³	kWh	7111.081455
E85	m³	MWh	7.111057191
E85	m³	GWh	0.007111057
E85	m³	TWh	7.11106E-06
E85	m³	MJ	25600
E85	m³	GJ	25.6
E85	m³	TJ	0.0256
E85	m³	Mcal	6114.436714
E85	m³	Gcal	6.114436714
E85	m³	Btu	24264022.9
E85	m³	kBtu	24264.0229
E85	m³	MMBtu	24.2640229
E85	m³	Therm	242.640229
E85	m³	Mtoe	6.11444E-07
E85	m³	BOE	4.184330749
Ethanol	m³	kWh	6503.38114
Ethanol	m³	MWh	6.503358949
Ethanol	m³	GWh	0.006503359
Ethanol	m³	TWh	6.50336E-06
Ethanol	m³	MJ	23412.26974
Ethanol	m³	GJ	23.41226974
Ethanol	m³	TJ	0.02341227
Ethanol	m³	Mcal	5591.907878
Ethanol	m³	Gcal	5.591907878
Ethanol	m³	Btu	22190462.86
Ethanol	m³	kBtu	22190.46286
Ethanol	m³	MMBtu	22.19046286
Ethanol	m³	Therm	221.9046286
Ethanol	m³	Mtoe	5.59191E-07
Ethanol	m³	BOE	3.82674532
Gas oil	m³	kWh	10808.00008
Gas oil	m³	MWh	10.80796321
Gas oil	m³	GWh	0.010807963
Gas oil	m³	TWh	1.0808E-05
Gas oil	m³	MJ	38908.96257
Gas oil	m³	GJ	38.90896257
Gas oil	m³	TJ	0.038908963
Gas oil	m³	Mcal	9293.21833
Gas oil	m³	Gcal	9.29321833
Gas oil	m³	Btu	36878435.89
Gas oil	m³	kBtu	36878.43589
Gas oil	m³	MMBtu	36.87843589
Gas oil	m³	Therm	368.7843589
Gas oil	m³	Mtoe	9.29322E-07
Gas oil	m³	BOE	6.359686269
Hydrogen	m³	kWh	3.363659559
Hydrogen	m³	MWh	0.003363648
Hydrogen	m³	GWh	3.36365E-06
Hydrogen	m³	TWh	3.36365E-09
Hydrogen	m³	MJ	12.10922491
Hydrogen	m³	GJ	0.012109225
Hydrogen	m³	TJ	1.21092E-05
Hydrogen	m³	Mcal	2.892230054
Hydrogen	m³	Gcal	0.00289223
Hydrogen	m³	Btu	11477.28557
Hydrogen	m³	kBtu	11.47728557
Hydrogen	m³	MMBtu	0.011477286
Hydrogen	m³	Therm	0.114772856
Hydrogen	m³	Mtoe	2.89223E-10
Hydrogen	m³	BOE	0.001979258
Jet gasoline	m³	kWh	9290.544485
Jet gasoline	m³	MWh	9.290512785
Jet gasoline	m³	GWh	0.009290513
Jet gasoline	m³	TWh	9.29051E-06
Jet gasoline	m³	MJ	33446.09963
Jet gasoline	m³	GJ	33.44609963
Jet gasoline	m³	TJ	0.0334461
Jet gasoline	m³	Mcal	7988.439826
Jet gasoline	m³	Gcal	7.988439826
Jet gasoline	m³	Btu	31700661.22
Jet gasoline	m³	kBtu	31700.66122
Jet gasoline	m³	MMBtu	31.70066122
Jet gasoline	m³	Therm	317.0066122
Jet gasoline	m³	Mtoe	7.98844E-07
Jet gasoline	m³	BOE	5.466779028
Jet kerosene	m³	kWh	10451.86255
Jet kerosene	m³	MWh	10.45182688
Jet kerosene	m³	GWh	0.010451827
Jet kerosene	m³	TWh	1.04518E-05
Jet kerosene	m³	MJ	37626.86208
Jet kerosene	m³	GJ	37.62686208
Jet kerosene	m³	TJ	0.037626862
Jet kerosene	m³	Mcal	8986.994804
Jet kerosene	m³	Gcal	8.986994804
Jet kerosene	m³	Btu	35663243.88
Jet kerosene	m³	kBtu	35663.24388
Jet kerosene	m³	MMBtu	35.66324388
Jet kerosene	m³	Therm	356.6324388
Jet kerosene	m³	Mtoe	8.98699E-07
Jet kerosene	m³	BOE	6.150126406
Kerosene	m³	kWh	10451.86255
Kerosene	m³	MWh	10.45182688
Kerosene	m³	GWh	0.010451827
Kerosene	m³	TWh	1.04518E-05
Kerosene	m³	MJ	37626.86208
Kerosene	m³	GJ	37.62686208
Kerosene	m³	TJ	0.037626862
Kerosene	m³	Mcal	8986.994804
Kerosene	m³	Gcal	8.986994804
Kerosene	m³	Btu	35663243.88
Kerosene	m³	kBtu	35663.24388
Kerosene	m³	MMBtu	35.66324388

Table 4.1

Coking coal	tonne	Therm	273.3732051
Coking coal	tonne	Mtoe	6.8889E-07
Coking coal	tonne	toe	4.714320922
E85	tonne	kWh	9194.4061
E85	tonne	MWh	9.194374728
E85	tonne	GWh	0.009194375
E85	tonne	TWh	9.19437E-06
E85	tonne	MJ	33100
E85	tonne	GJ	33.1
E85	tonne	TJ	0.0331
E85	tonne	Mcal	7905.775596
E85	tonne	Gcal	7.905775596
E85	tonne	Btu	31372623.36
E85	tonne	kBtu	31372.62336
E85	tonne	MMBtu	31.37262336
E85	tonne	Therm	313.7262336
E85	tonne	Mtoe	7.90578E-07
E85	tonne	toe	5.410208898
Municipal wastes (all)	tonne	kWh	3214.402008
Municipal wastes (all)	tonne	MWh	3.21439104
Municipal wastes (all)	tonne	GWh	0.003214391
Municipal wastes (all)	tonne	TWh	3.21439E-06
Municipal wastes (all)	tonne	MJ	11571.89549
Municipal wastes (all)	tonne	GJ	11.57189549
Municipal wastes (all)	tonne	TJ	0.011571895
Municipal wastes (all)	tonne	Mcal	2763.891509
Municipal wastes (all)	tonne	Gcal	2.763891509
Municipal wastes (all)	tonne	Btu	10967997.54
Municipal wastes (all)	tonne	kBtu	10967.99754
Municipal wastes (all)	tonne	MMBtu	10.96799754
Municipal wastes (all)	tonne	Therm	109.6799754
Municipal wastes (all)	tonne	Mtoe	2.76389E-07
Municipal wastes (all)	tonne	toe	1.891431176
Municipal wastes (non-biomas	tonne	kWh	7430.275999
Municipal wastes (non-biomas	tonne	MWh	7.430250646
Municipal wastes (non-biomas	tonne	GWh	0.007430251
Municipal wastes (non-biomas	tonne	TWh	7.43025E-06
Municipal wastes (non-biomas	tonne	MJ	26749.10515
Municipal wastes (non-biomas	tonne	GJ	26.74910515
Municipal wastes (non-biomas	tonne	TJ	0.026749105
Municipal wastes (non-biomas	tonne	Mcal	6388.894945
Municipal wastes (non-biomas	tonne	Gcal	6.388894945
Municipal wastes (non-biomas	tonne	Btu	25353160.15
Municipal wastes (non-biomas	tonne	kBtu	25353.16015
Municipal wastes (non-biomas	tonne	MMBtu	25.35316015
Municipal wastes (non-biomas	tonne	Therm	253.5316015
Municipal wastes (non-biomas	tonne	Mtoe	6.38889E-07
Municipal wastes (non-biomas	tonne	toe	4.372152468
Municipal wastes (biomass fra	tonne	kWh	3585.915808
Municipal wastes (biomass fra	tonne	MWh	3.585903572
Municipal wastes (biomass fra	tonne	GWh	0.003585904
Municipal wastes (biomass fra	tonne	TWh	3.5859E-06
Municipal wastes (biomass fra	tonne	MJ	12909.35075
Municipal wastes (biomass fra	tonne	GJ	12.90935075
Municipal wastes (biomass fra	tonne	TJ	0.012909351
Municipal wastes (biomass fra	tonne	Mcal	3083.336256
Municipal wastes (biomass fra	tonne	Gcal	3.083336256
Municipal wastes (biomass fra	tonne	Btu	12235655.55
Municipal wastes (biomass fra	tonne	kBtu	12235.65555
Municipal wastes (biomass fra	tonne	MMBtu	12.23565555
Municipal wastes (biomass fra	tonne	Therm	122.3565555
Municipal wastes (biomass fra	tonne	Mtoe	3.08334E-07
Municipal wastes (biomass fra	tonne	toe	2.1100388
Other Liquid BioFuels	tonne	kWh	7611.07937
Other Liquid BioFuels	tonne	MWh	7.6110534
Other Liquid BioFuels	tonne	GWh	0.007611053
Other Liquid BioFuels	tonne	TWh	7.61105E-06
Other Liquid BioFuels	tonne	MJ	27400
Other Liquid BioFuels	tonne	GJ	27.4
Other Liquid BioFuels	tonne	TJ	0.0274
Other Liquid BioFuels	tonne	Mcal	6544.358046
Other Liquid BioFuels	tonne	Gcal	6.544358046
Other Liquid BioFuels	tonne	Btu	25970087.01
Other Liquid BioFuels	tonne	kBtu	25970.08701
Other Liquid BioFuels	tonne	MMBtu	25.97008701
Other Liquid BioFuels	tonne	Therm	259.7008701
Other Liquid BioFuels	tonne	Mtoe	6.54436E-07
Other Liquid BioFuels	tonne	toe	4.478541505
Petroleum coke	tonne	kWh	9027.740129
Petroleum coke	tonne	MWh	9.027709325
Petroleum coke	tonne	GWh	0.009027709
Petroleum coke	tonne	TWh	9.02771E-06
Petroleum coke	tonne	MJ	32500
Petroleum coke	tonne	GJ	32.5
Petroleum coke	tonne	TJ	0.0325
Petroleum coke	tonne	Mcal	7762.468485
Petroleum coke	tonne	Gcal	7.762468485
Petroleum coke	tonne	Btu	30803935.32
Petroleum coke	tonne	kBtu	30803.93532
Petroleum coke	tonne	MMBtu	30.80393532
Petroleum coke	tonne	Therm	308.0393532
Petroleum coke	tonne	Mtoe	7.76247E-07
Petroleum coke	tonne	toe	5.312138646
Sewage sludge	tonne	kWh	1055.551153
Sewage sludge	tonne	MWh	1.055547552
Sewage sludge	tonne	GWh	0.001055548
Sewage sludge	tonne	TWh	1.05555E-06
Sewage sludge	tonne	MJ	3800
Sewage sludge	tonne	GJ	3.8
Sewage sludge	tonne	TJ	0.0038
Sewage sludge	tonne	Mcal	907.6116998
Sewage sludge	tonne	Gcal	0.9076117
Sewage sludge	tonne	Btu	3601690.899
Sewage sludge	tonne	kBtu	3601.690899
Sewage sludge	tonne	MMBtu	3.601690899
Sewage sludge	tonne	Therm	36.01690899
Sewage sludge	tonne	Mtoe	9.07612E-08
Sewage sludge	tonne	toe	0.621111596
Town gas or city gas	tonne	kWh	10660.83078
Town gas or city gas	tonne	MWh	10.6607944
Town gas or city gas	tonne	GWh	0.010660794
Town gas or city gas	tonne	TWh	1.06608E-05
Town gas or city gas	tonne	MJ	38379.15087
Town gas or city gas	tonne	GJ	38.37915087
Town gas or city gas	tonne	TJ	0.038379151
Town gas or city gas	tonne	Mcal	9166.675357
Town gas or city gas	tonne	Gcal	9.166675357
Town gas or city gas	tonne	Btu	36376273.26
Town gas or city gas	tonne	kBtu	36376.27326
Town gas or city gas	tonne	MMBtu	36.37627326
Town gas or city gas	tonne	Therm	363.7627326
Town gas or city gas	tonne	Mtoe	9.16668E-07
Town gas or city gas	tonne	toe	6.273088324
Wood or wood waste	tonne	kWh	5647.009759
Wood or wood waste	tonne	MWh	5.646990491
Wood or wood waste	tonne	GWh	0.00564699
Wood or wood waste	tonne	TWh	5.64699E-06
Wood or wood waste	tonne	MJ	20329.31991
Wood or wood waste	tonne	GJ	20.32931991
Wood or wood waste	tonne	TJ	0.02032932
Wood or wood waste	tonne	Mcal	4855.560159
Wood or wood waste	tonne	Gcal	4.855560159
Wood or wood waste	tonne	Btu	19268401.71
Wood or wood waste	tonne	kBtu	19268.40171
Wood or wood waste	tonne	MMBtu	19.26840171
Wood or wood waste	tonne	Therm	192.6840171
Wood or wood waste	tonne	Mtoe	4.85556E-07
Wood or wood waste	tonne	toe	3.322835876

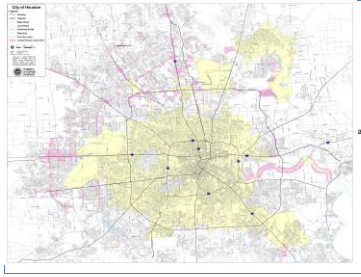
Source: International Energy Agency www.iea.org/newsroomandevents/resources/conversiontables and www.onlineconversion.com

A. INVENTORY BOUNDARY (GPC CHAPTER 4.4, TABLE 4.1, PAGE 40)

Boundary	Information	Reference(s)
Name of city	Houston	
Country	USA	
Region	North America	
Inventory year (select from list)	2014	*Calendar year*
Geographic boundary (select from list)	City / Municipality	*City of Houston Planning and Development Department - Boundary Map*
Heating degree days (HDD, °C)*	499	*16 °C*
Cooling degree days (CDD, °C)*	2330	*16 °C*
Land area (km2) within city boundary	1,553	https://www.census.gov/quickfacts/table/LND110210/4835000,00
Resident population within city boundary*	2,239,558	https://www.census.gov/data/datasets/2016/demo/popest/total-cities-and-towns.html
GDP (US$) of economic activity within city boundary*	522,028,000,000	Bureau of Economic Analysis https://www.bea.gov/itable/iTable.cfm?ReqID=70&step=1#reqid=70&step=10&isuri=1&7003=200&7035=-
Type of economy (select from list)	Other (please specify)	Oil and Gas, Services
Climate (select from list)	Temperate, hot summer	http://people.eng.unimelb.edu.au/mpeel/koppen.html
Other information		

* Should correspond to inventory year

B. MAP OF CITY BOUNDARY



a map of your city boundary in this box
(use insert > picture from file)

C. INVENTORY INFORMATION

Inventory	Information
GPC reporting level (select from list)	BASIC
Greenhouse gases included in inventory (select from list)	CO2, CH4, N2O
Global Warming Potential (select relevant IPCC AR from list)	IPCC Fourth Assessment Report (2007)
Please explain your choice of GWP (if not AR4 or AR5)	
Description of overall methodology and tools used	The inventory is consistent with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC), unless otherwise noted. All external data sources and emission factors are documented. Any assumptions made are documented appropriately in the relevant sector.
Relevant local, regional and national regulations	No specific regulations around the development of city-wide GHG inventories. Key government stakeholders are Houston-Galveston Area Council, Texas Council on Environmental Quality, and City of Houston's Planning Department.
Comments on change in total emissions since last reported inventory	
Has the inventory been audited or verified by a third party?	No
Planned improvements	In future years, the City of Houston will attempt to generate updated on-road transportation data using an origin-destination method, and will attempt to acquire data for waterborne navigation and fugitive emissions from oil and natural gas processing as well as identify potential private industrial WWTPs operating within the city limits to identify emissions.

D. INVENTORY COMPILER

Inventory	Information
Compiler name	Lara Cottingham, Larissa Williams
Department	Administration and Regulatory Affairs (ARA)
Date	5/17/2018
Version	2014 Inventory
Email	Lara.Cottingham@houstontx.gov; Larissa.Williams@houstontx.gov
Webpage	www.houstontx.gov

DATA SOURCES (GPC CHAPTER 5.4, PAGE 48)

Use this table to record all the data sources used to compile the inventory. The "Add" function allows you to select the required number of rows. References provided in the "Name of source" column may be used to select the relevant data sources in the emission factors and sector tabs. Data can be gathered from a variety of sources, including government departments and statistics agencies, a country's national GHG inventory report, universities, scientific and technical articles in environmental books, journals and reports, and sector experts/stakeholder organizations. In general, it is preferable to use local and national data over international data, and data from publicly-available, peer-reviewed and reputable sources.

	Data	Name of source	Provider	Latest year	Period	Frequency	Scale	Link
45	*EXAMPLE: Emission factors*	*National emissions factor database*	*Ministry of the Environment*	*2014*	*Calendar year*	*Annual*	*National*	*www.ipcc-nggip.iges.or.jp/EFDB/main.php*
	Electricity emission factor	National electricity emission factor database	U.S. Environmental Protection Agency	2012	Calendar year	Every 2 years	Regional	https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid
	Natural gas emission factor	National emission factor database	U.S. Environmental Protection Agency	2015	Calendar year	Every 2 years	National	https://www.epa.gov/sites/production/files/2016-09/documents/emission-factors_nov_2015_v2.pdf
	Natural gas use	Center Point Energy natural gas use data	Center Point Energy	2014	Calendar year	Annual	Local	
	Electricity use	Center Point Energy electricity use data	Center Point Energy	2014	Calendar year	Annual	Local	
	Transportation - Vehicle Miles Traveled	HGAC, Texas A&M Transportation Institute (TTI)	Graciela Lubertino - Chief Air Quality Planner (HGAC); L.D. White - Research Specialist, Transportation Modeling Program (TTI)	2014	Calendar year	Annual	Local	http://www.h-gac.com/home/residents.aspx; https://tti.tamu.edu/
	Wastewater	Walid Samarneh (WWTP Managing Engineer)	City of Houston Public Works and Engineering Department	2014	Calendar year	Annual	Local	https://www.publicworks.houstontx.gov/home
	City Boundary	Sona Sunny (Senior GIS Analyst)	City of Houston Planning and Development Department	2015	Calendar year	Annual	Local	http://mycity.houstontx.gov/home/maps.html
	Transportation - Rail, Water, Aviation	Matthew Southard (Team Leader Area and Mobile Source Inventory Team)	Texas Commission on Environmental Quality (TCEQ)	2014	Calendar year	Annual	Local	https://www.tceq.texas.gov/agency/air_main.html#sip
	Transportation - Rail, Water, Aviation	Heather Perez (GIS Manager)	Eastern Research Group, Inc. (contractor to TCEQ)	2014	Calendar year	Annual	Local	http://www.erg.com/
	Landfill	Sarah Mason (Recycling Division Manager)	City of Houston Solid Waste Management Department	2014	Calendar year	Annual	Local	http://www.houstontx.gov/solidwaste/
	Commuter rail emission factor	National emission factor database	U.S. Environmental Protection Agency	2015	Calendar year	Every 2 years	National	https://www.epa.gov/sites/production/files/2016-09/documents/emission-factors_nov_2015_v2.pdf
	Passenger rail emission factor	National emission factor database	U.S. Environmental Protection Agency	2015	Calendar year	Every 2 years	National	https://www.epa.gov/sites/production/files/2016-09/documents/emission-factors_nov_2015_v2.pdf
	Emissions from energy generation supplied to grid	U.S. EPA FLIGHT tool	U.S. Environmental Protection Agency	2016	Calendar year	Annual	National	https://ghgdata.epa.gov/ghgp/main.do
	Commuter rail activity data	Commuter rail activity data	Metropolitan Transit Authority of Harris County, Texas	2014	Calendar year	Annual	Regional	https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/60008_0.pdf
	Solid waste generation	Total solid waste generation	Texas Commission on Environmental Quality (TCEQ)	2014	Calendar year	Annual	Regional	https://www.tceq.texas.gov/assets/public/comm_exec/pubs/as/187-16.pdf
	Population	Total population	U.S. Census Bureau	2014	Calendar year	Annual	Local	https://www.census.gov/data/datasets/2016/demo/popest/total-cities-and-towns.html
	Passenger rail passenger miles: passenger rail track miles and total passengers	Total passenger miles	U.S. Department of Transportation; Amtrak	2014	Calendar year	Annual	Local	http://osav-usdot.opendata.arcgis.com/datasets?keyword=Rail; https://www.narprail.org/site/assets/files/2047/hos.pdf
	Aviation activity data	Aviation activity data	Thomas Hollier, City of Houston Fleet Management Department	2014	Calendar year	Annual	Local	
	Freight rail activity data	Freight rail activity data	Eastern Research Group, Inc. (contractor to TCEQ); Heather Perez	2014	Calendar year	Annual	Local	http://www.erg.com/
	On-road vehicle emission factor - gasoline motorcycles	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - gasoline passenger cars	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - gasoline passenger trucks	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - gasoline light commercial trucks	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - gasoline school buses	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - gasoline refuse truck	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - gasoline single unit short-haul trucks	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - gasoline single unit long-haul trucks	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - gasoline motor homes	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - gasoline combination short-haul trucks	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - gasoline diesel passenger cars	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - diesel passenger trucks	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - diesel light commercial trucks	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - diesel intercity buses	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - diesel transit buses	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - diesel school buses	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - diesel refuse trucks	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - diesel single unit short-haul trucks	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - diesel single unit long-haul trucks	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - diesel motor homes	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - diesel combination short-haul trucks	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	On-road vehicle emission factor - diesel combination long-haul trucks	Houston-Galveston Area Council - MOVES model	Houston-Galveston Area Council	2014	Calendar year	Annual	Local	
	Solid waste composition	EPA report: Advancing Sustainable Materials Management: 2014 Tables and	U.S. Environmental Protection Agency	2016	Calendar year	Annual	National	https://www.epa.gov/sites/production/files/2016-11/documents/2014_smm_tablesfigures_508.pdf
	Landfill facility data (McCarty Road)	U.S. EPA FLIGHT tool	U.S. Environmental Protection Agency	2017	Calendar year	Annual	Local	https://ghgdata.epa.gov/ghgp/service/facilityDetail/2014?id=1006899&ds=E&et=&popup=true
	City waste sent to McCarty Road	City of Houston Solid Waste Management Department	City of Houston Solid Waste Management Department	2014	Calendar year	Annual	Local	Provided via email
	Industrial WWTP characteristics	City of Houston 2007 GHG inventory report and technical appendices	City of Houston	2007	Calendar year	Once	Local	http://www.greenhoustontx.gov/reports/2007-community-inventory.pdf

EMISSION FACTORS

Use this table to record the emission factors used to calculate GHG emissions for all activities included in the inventory. Emission factors convert activity data into a mass of GHG emissions. The "Add" function allows you to select the required number of rows. Names provided in the 'Unique identifier' column shall be used to identify the relevant emission factors in the sector tabs. Select "GHG" in the *'Type' column* if emission factors have not been converted into units of CO2-equivalent. Select "CO2e" if they have. Emission factors should be recorded for each gas separately. If these are not available, an emission factor for total CO2e may be used.

	Fuel type or activity	Unique identifier	Type	GWP	Units	Convert to tonnes	Emission factor									Data quality	Year	Scale	Description	Source
							CO_2	tCO2e	CH_4	CH_4 tCO2e	N_2O	N_2O tCO2e	Total CO_2e	tCO2e	CO_2(b)	tCO$_2$(b)				
35	*EXAMPLE: Natural*	*EXAMPLE: EF_Natural*	*CO2e*	*5AR*	*kg / kWh*	*0.001*	*0.4822*	*0.0004822*	*0.003*	0.000003	*0.0029*	0.000003	*0.4881*	*0.000488*	*0.09644*	*0.00009644*	*H*	*2014*	*National*	*Emission factor for grid-supplied natural gas*	*National emissions factor database*
	Natural gas	EF_Natural gas	GHG	4AR	kg / scf	0.001	0.0544	5.44E-05	0.0000	2.58E-08	0.0000	2.98E-08					H	2014	National	Emission factor for pipeline natural gas (U.S. average)	National emission factor database
	Electricity	EF_Electricity (2010)	GHG	2AR	lb / MWh	0.000453597	1218.1700	5.53E-01	0.0169	1.61E-04	0.0140	1.97E-03					H	2010	Regional	Emission factor for grid-supplied electricity (eGRID2010 - ERCT) - for comparison to previous GHG inventory completed using ICLEI CACP software	National electricity emission factor database
	Distance travelled (passenger)	EF_Amtrak	GHG	4AR	kg / passe	0.001	0.1360	1.36E-04	0.0000	2.08E-07	0.0000	8.94E-07					H	2015	National	Intercity rail Business Travel Emission factor, U.S. EPA EF hub nov2015v2, Table 8	National emission factor database
	Distance travelled (passenger)	EF_commuter rail	GHG	4AR	kg / passe	0.001	0.1690	1.69E-04	0.0000	2.13E-07	0.0000	1.01E-06					H	2015	National	Commuter rail Business Travel Emission factor, U.S. EPA EF hub nov2015v2, Table 8	National emission factor database
	Aviation gasoline	EF_aviation gasoline	GHG	4AR	kg / gallon	0.001	8.3100	8.31E-03	0.0004	9.02E-06	0.0001	2.09E-05					H	2015	National	U.S. EPA EF hub nov2015v2, Tables 2 and 5	National emission factor database
	Jet kerosene	EF_jet kerosene	GHG	4AR	kg / gallon	0.001	9.7500	9.75E-03	0.0004	1.03E-05	0.0001	2.38E-05					H	2015	National	U.S. EPA EF hub nov2015v2, Tables 2 and 5	National emission factor database
	Please select	EF_locomotive diesel	GHG	4AR	kg / gallon	0.001	10.2100	1.02E-02	0.0008	2.00E-05	0.0003	7.75E-05					H	2015	National	Diesel (CO2) and diesel locomotive (CH4 and N2O) Emission factor, U.S. EPA EF hub nov2015v2, Tables 2 and 5	National emission factor database
	Electricity	EF_Electricity 2012	GHG	4AR	lb / MWh	0.000453597	1143.0400	5.18E-01	0.0167	1.89E-04	0.0123	1.67E-03					H	2012	Regional	Emission factor for grid-supplied electricity (eGRID2012 - ERCT). **Use of EPA eGRID2019v2 emission factors are not recommended due to inconsistent methodology with previous versions of eGRID. Therefore, eGRID2012 factors are recommended for year**	National electricity emission factor database
	Motor gasoline (vehicl	EF_gas motorcycles	GHG	4AR	kg / mile	0.001	0.3782722	3.78E-04	0.0000	9.25E-07	0.0000	2.36E-06					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Motor gasoline (vehicl	EF_gas passenger	GHG	4AR	kg / mile	0.001	0.3678	3.68E-04	0.0000	1.82E-07	0.0000	2.67E-06					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Motor gasoline (vehicl	EF_gas passenger truck	GHG	4AR	kg / mile	0.001	0.5078	5.08E-04	0.0000	5.07E-07	0.0000	6.65E-06					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Motor gasoline (vehicl	EF_gas light commercial trucks	GHG	4AR	kg / mile	0.001	0.5061	5.06E-04	0.0000	6.80E-07	0.0000	8.95E-06					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Motor gasoline (vehicl	EF_gas school buses	GHG	4AR	kg / mile	0.001	0.9737	9.74E-04	0.0003	7.75E-06	0.0001	3.81E-05					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Motor gasoline (vehicl	EF_gas refuse trucks	GHG	4AR	kg / mile	0.001	1.7903	1.79E-03	0.0000	5.67E-07	0.0000	4.15E-06					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Motor gasoline (vehicl	EF_gas single unit short-haul trucks	GHG	4AR	kg / mile	0.001	1.0612	1.06E-03	0.0000	5.44E-07	0.0000	9.30E-06					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Motor gasoline (vehicl	EF_gas single unit long-haul trucks	GHG	4AR	kg / mile	0.001	0.9888	9.89E-04	0.0000	4.58E-07	0.0000	6.84E-06					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Motor gasoline (vehicl	EF_gas motor homes	GHG	4AR	kg / mile	0.001	1.0592	1.06E-03	0.0000	1.17E-06	0.0000	7.04E-06					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Motor gasoline (vehicl	EF_gas combination short-haul trucks	GHG	4AR	kg / mile	0.001	1.7786	1.78E-03	0.0000	1.03E-06	0.0000	9.76E-06					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Diesel oil	EF_diesel passenger truck	GHG	4AR	kg / mile	0.001	0.3056	3.96E-04	0.0000	3.92E-07	0.0000	1.50E-07					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Diesel oil	EF_diesel passenger	GHG	4AR	kg / mile	0.001	0.7234	7.23E-04	0.0000	7.63E-07	0.0000	6.73E-07					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Diesel oil	EF_diesel light commercial trucks	GHG	4AR	kg / mile	0.001	0.7442	7.44E-04	0.0000	9.85E-07	0.0000	1.08E-06					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Diesel oil	EF_diesel motorcycles	GHG	4AR	kg / mile	0.001	1.8713	1.87E-03	0.0000	5.50E-07	0.0000	9.26E-07					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Diesel oil	EF_diesel transit buses	GHG	4AR	kg / mile	0.001	1.4054	1.41E-03	0.0000	5.30E-07	0.0000	6.72E-07					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Diesel oil	EF_diesel school buses	GHG	4AR	kg / mile	0.001	0.9559	9.56E-04	0.0000	5.27E-07	0.0000	7.19E-07					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Diesel oil	EF_diesel refuse trucks	GHG	4AR	kg / mile	0.001	1.9049	1.90E-03	0.0000	7.74E-07	0.0000	6.82E-07					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Diesel oil	EF_diesel single unit short-haul trucks	GHG	4AR	kg / mile	0.001	1.0921	1.09E-03	0.0000	1.13E-06	0.0000	9.25E-07					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Diesel oil	EF_diesel single unit long-haul trucks	GHG	4AR	kg / mile	0.001	1.0217	1.02E-03	0.0000	1.11E-06	0.0000	8.22E-07					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Diesel oil	EF_diesel motor homes	GHG	4AR	kg / mile	0.001	1.1071	1.11E-03	0.0000	7.58E-07	0.0000	6.38E-07					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Diesel oil	EF_diesel combination short-haul trucks	GHG	4AR	kg / mile	0.001	1.9100	1.91E-03	0.0000	8.53E-07	0.0000	6.77E-07					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Diesel oil	EF_diesel combination long-haul trucks	GHG	4AR	kg / mile	0.001	2.0553	2.06E-03	0.0001	3.03E-06	0.0000	6.22E-07					H	2014	Local	Distance-based emission factor calculated using EPA's MOVES model	Houston-Galveston Area Council - MOVES model
	Please select		Please select	Please select													Please select	Please select	Please select		Please select
	Please select		Please select	Please select													Please select	Please select	Please select		Please select

CIRIS

Introduction	Set-up	Inventory	Calculators	Results	Notes
Stationary	Transportation	Waste	IPPU	AFOLU	Scope 3

I STATIONARY ENERGY (GPC CHAPTER 6, PAGE 54)

Use this tab to record activity and emissions data for Stationary energy sources. The "Add" function allows you to select the required number of rows for each section. Emission factors should be recorded in the 'Emission factors' tab. Use the 'Activity data unit converter' if activity data units do not match the emission factor selected. Notation keys should be used for each section where no data is reported. Some BASIC and all BASIC+ activities been pre-assigned the notation keys NO and NE respectively. Please delete these and the explanation if you have activity or emissions data for these activities.

Enter activity data — Select an emission factor — OR — Enter emissions data

I.1 RESIDENTIAL BUILDINGS

	GPC ref No.	Scope	GHG Emissions Source			Notation keys	Activity data		Activity data unit converter			Gas(es)	Emission factor	Emission factor						Oxidation factor		Emissions data	GHGs (metric tonnes CO_2e)					GHGs (metric tonnes CO_2e)					Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
			Sub-category	Activity	Description		Amount	Unit	EF unit	Default	Override			Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Default	Override		CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	AD			
1	I.1.1	1	**Emissions from fuel combustion within the city boundary**																																	
	I.1.1	1	Residential (1.A.4.b)	Natural gas	Residential natural gas use		20,568,891	Mcf	cf (ft3)	1.00E+03		CO2, CH4, N2O	EF_Natural gas	tCO2e/scf	0.00005444	2.575E-08	2.98E-08			1								1,119,770	530	613	1,120,913	-	M	Activity data multiplied by emission factor	Center Point Energy natural gas use	Data provided by utility - assumed to have moderate quality assurance conducted by City of Houston
2	I.1.2	2	**Emissions from grid-supplied energy consumed within the city boundary**																																	
	I.1.2	2	Residential (1.A.4.b)	Electricity	Single family electricity use		5,298,368,362	kWh	MWh	1.00E-03		CO2, CH4, N2O	EF_Electricity 2012	tCO2e/MWh	0.518479543	0.000189388	0.00166667			1								2,747,096	1,003	8,831	2,756,930	-	M	Activity data multiplied by emission factor	Center Point Energy electricity use	Data provided by utility - assumed to have moderate quality assurance conducted by City of Houston
	I.1.2	2	Residential (1.A.4.b)	Electricity	Multi-familty electricity use		2,969,250,196	kWh	MWh	1.00E-03		CO2, CH4, N2O	EF_Electricity 2012	tCO2e/MWh	0.518479543	0.000189388	0.00166667			1								1,539,495	562	4,949	1,545,007	-	M	Activity data multiplied by emission factor	Center Point Energy electricity use	Data provided by utility - assumed to have moderate quality assurance conducted by City of Houston
Add	I.1.3	3	**Transmission and distribution losses from grid-supplied energy**			NE																												I.1.3 has not been estimated; not required for BASIC		

I.2 COMMERCIAL AND INSTITUTIONAL BUILDINGS AND FACILITIES (please report emissions from commercial use and institutional use separarely, where possible)

	GPC ref No.	Scope	GHG Emissions Source			Notation keys	Activity data		Activity data unit converter			Gas(es)	Emission factor	Emission factor						Oxidation factor		Emissions data	GHGs (metric tonnes CO_2e)					GHGs (metric tonnes CO2e)					Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
			Sub-category	Activity	Description		Amount	Unit	EF unit	Default	Override			Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Default	Override		CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	CO2	CH4	N2O	Total tCO2e	CO2(b)	AD			
3	I.2.1	1	**Emissions from fuel combustion within the city boundary**																																	
	I.2.1	1	Commercial / Institutional (I.A.4.a)	Natural gas	Small commercial natural gas use		6,191,780	Mcf	cf (ft3)	1.00E+03		CO2, CH4, N2O	EF_Natural gas	tCO2e/scf	0.00005444	2.575E-08	2.98E-08			1								337,081	159	185	337,424	-	M	Activity data multiplied by emission factor	Center Point Energy natural gas use	Data provided by utility - assumed to have moderate quality assurance conducted by City of Houston
	I.2.1	1	Commercial / Institutional (I.A.4.a)	Natural gas	Large commercial natural gas use		3,877,267	Mcf	cf (ft3)	1.00E+03		CO2, CH4, N2O	EF_Natural gas	tCO2e/scf	0.00005444	2.575E-08	2.98E-08			1								211,078	100	116	211,294	-	M	Activity data multiplied by emission factor	Center Point Energy natural gas use	Data provided by utility - assumed to have moderate quality assurance conducted by City of Houston
	I.2.1	1	Commercial	Natural gas	Company (CenterPoint Energy) natural gas use		3,896	Mcf	cf (ft3)	1.00E+03		CO2, CH4, N2O	EF_Natural gas	tCO2e/scf	0.00005444	2.575E-08	2.98E-08			1								212	0	0	212	-	M	Activity data multiplied by emission factor	Center Point Energy natural gas use	Data provided by utility - assumed to have moderate quality assurance conducted by City of Houston
2	I.2.2	2	**Emissions from grid-supplied energy consumed within the city boundary**																																	
	I.2.2	2	Commercial	Electricity	Small commercial electricity use		7,288,185,680	kWh	MWh	1.00E-03		CO2, CH4, N2O	EF_Electricity 2012	tCO2e/MWh	0.518479543	0.000189388	0.00166667			1								3,778,775	1,380	12,147	3,792,302	-	M	Activity data multiplied by emission factor	Center Point Energy electricity use	Data provided by utility - assumed to have moderate quality assurance conducted by City of Houston
	I.2.2	2	Commercial	Electricity	Large commercial and industrial electricity use		10,539,878,382	kWh	MWh	1.00E-03		CO2, CH4, N2O	EF_Electricity 2012	tCO2e/MWh	0.518479543	0.000189388	0.00166667			1								5,464,711	1,996	17,566	5,484,274	-	M	Activity data multiplied by emission factor	Center Point Energy electricity use	Data provided by utility - assumed to have moderate quality assurance conducted by City of Houston
Add	I.2.3	3	**Transmission and distribution losses from grid-supplied energy**			NE																												I.2.3 has not been estimated; not required for BASIC		

I.3 MANUFACTURING INDUSTRIES AND CONSTRUCTION

	GPC ref No.	Scope	GHG Emissions Source			Notation keys	Activity data		Activity data unit converter			Gas(es)	Emission factor	Emission factor						Oxidation factor		Emissions data	GHGs (metric tonnes CO_2e)					GHGs (metric tonnes CO_2e)					Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
			Sub-category	Activity	Description		Amount	Unit	EF unit	Default	Override			Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Default	Override		CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	AD			
2	I.3.1	1	**Emissions from fuel combustion within the city boundary**																																	
	I.3.1	1	Manufacturing industries and construction (1.A.2)	Natural gas	Small industrial natural gas use		92,198	Mcf	cf (ft3)	1.00E+03		CO2, CH4, N2O	EF_Natural gas	tCO2e/scf	0.00005444	2.575E-08	2.98E-08			1								5,019	2	3	5,024	-	M	Activity data multiplied by emission factor	Center Point Energy natural gas use	Data provided by utility - assumed to have moderate quality assurance conducted by City of Houston
	I.3.1	1	Manufacturing industries and construction (1.A.2)	Natural gas	Transportation natural gas use - service class refers to natural gas not owned by utility -		21,299,631	Mcf	cf (ft3)	1.00E+03		CO2, CH4, N2O	EF_Natural gas	tCO2e/scf	0.00005444	2.575E-08	2.98E-08			1								1,159,552	548	635	1,160,735	-	M	Activity data multiplied by emission factor	Center Point Energy natural gas use	Data provided by utility - assumed to have moderate quality assurance conducted by City of Houston
Add	I.3.2	2	**Emissions from grid-supplied energy consumed within the city boundary**			IE																												I.3.2 are included in I.2.2		
Add	I.3.3	3	**Transmission and distribution losses from grid-supplied energy**			NE																												I.3.3 has not been estimated; not required for BASIC		

I.4 ENERGY INDUSTRIES

	GPC ref No.	Scope	GHG Emissions Source			Notation keys	Activity data		Activity data unit converter			Gas(es)	Emission factor	Emission factor						Oxidation factor		Emissions data	GHGs (metric tonnes CO_2e)					GHGs (metric tonnes CO_2e)					Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
			Sub-category	Activity	Description		Amount	Unit	EF unit	Default	Override			Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Default	Override		CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	AD			
1	I.4.1	1	**Emissions from fuel combustion within the city boundary**			IE																												I.4.1 are included in I.2.1		
	I.4.1	1	Please select	Other (please specify)									Please select	tCO2e/	0	0	0	0	0														Please select			
Add	I.4.2	2	**Emissions from grid-supplied energy consumed within the city boundary**			IE																												I.4.2 are included in I.2.2.		
Add	I.4.3	3	**Transmission and distribution losses from grid-supplied energy**			NE																												I.4.3 has not been estimated; not required for BASIC		
4	I.4.4	1	**Emissions from energy generation supplied to the grid**																																	
	I.4.4	1	Electricity generation (1.A.1.a.i)	Electricity generation	TH Warton			Please select				CO2, CH4, N2O	Please select	tCO2e/	0	0	0	0	0			✓	149,342	70	83			149342	70	83	149495	-	H	Data acquired from U.S. EPA FLIGHT tool, only GHGs from electricity generation (subpart D)	U.S. EPA FLIGHT tool	Data reported to U.S. EPA directly by facility
	I.4.4	1	Electricity generation (1.A.1.a.i)	Electricity generation	Greens Bayou			Please select				CO2, CH4, N2O	Please select	tCO2e/	0	0	0	0	0			✓	60,742	28	34			60742	28	34	60804	-	H	Data acquired from U.S. EPA FLIGHT tool, only GHGs from electricity generation (subpart D)	U.S. EPA FLIGHT tool	Data reported to U.S. EPA directly by facility
	I.4.4	1	Landfill Gas	Other (please specify)	McCarty Road Landfill		110,223	tonne				CO2, CH4	Please select	tCO2e/	0	0	0	0	0			✓		12,002			25,083	-	12002	-	12002	25083	M	Activity data provided by City of Houston, composition data MSW% gathered from national EPA report (see "Solid Waste Disposal" sheet for details), GHG emissions calculated using Solid Waste Disposal calculator in CIRIS	Sarah Mason (Recycling Division Manager)	Data reported to U.S. EPA directly by facility
	I.4.4	1	Landfill Gas	Other (please specify)	McCarty Road Landfill		1,809,316	tonne				CO2, CH4	Please select	tCO2e/	0	0	0	0	0			✓		197,007			411,745	-	197007	-	197007	411745	M	Activity data calculated from EPA Flight database and information from City of Houston (see "Solid Waste Disposal" sheet for details). GHG emissions calculated using Solid Waste Disposal calculator in CIRIS	U.S. EPA FLIGHT tool	Data reported to U.S. EPA directly by facility

I.5 AGRICULTURE, FORESTRY AND FISHING ACTIVITIES

	GPC ref No.	Scope	GHG Emissions Source			Notation keys	Activity data		Activity data unit converter			Gas(es)	Emission factor	Emission factor						Oxidation factor		Emissions data	GHGs (metric tonnes CO_2e)					GHGs (metric tonnes CO_2e)					Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
			Sub-category	Activity	Description		Amount	Unit	EF unit	Default	Override			Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Default	Override		CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	AD			
Add	I.5.1	1	**Emissions from fuel combustion within the city boundary**			IE																												I.5.1 are assumed to be included in I.2.1 and I.3.1		
Add	I.5.2	2	**Emissions from grid-supplied energy consumed within the city boundary**			IE																												I.5.2 are assumed to be included in 1.2.2 and I.3.2		
Add	I.5.3	3	**Transmission and distribution losses from grid-supplied energy**			NE																												I.5.3 has not been estimated; not required for BASIC		

I.6 NON-SPECIFIED SOURCES

	GPC ref No.	Scope	GHG Emissions Source			Notation keys	Activity data		Activity data unit converter			Gas(es)	Emission factor	Emission factor						Oxidation factor		Emissions data	GHGs (metric tonnes CO_2e)					GHGs (metric tonnes CO_2e)					Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
			Sub-category	Activity	Description		Amount	Unit	EF unit	Default	Override			Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Default	Override		CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	AD			
Add	I.6.1	1	**Emissions from fuel combustion within the city boundary**			NO																												I.6.1 does not occur		
Add	I.6.2	2	**Emissions from grid-supplied energy consumed within the city boundary**			NO																												I.6.2 does not occur		
Add	I.6.3	3	**Transmission and distribution losses from grid-supplied energy**			NE																												I.6.3 has not been estimated; not required for BASIC		

I.7 FUGITIVE EMISSIONS FROM MINING, PROCESSING, STORAGE AND TRANSPORTATION OF COAL

	GPC ref No.	Scope	GHG Emissions Source			Notation keys	Activity data		Activity data unit converter			Gas(es)	Emission factor	Emission factor						Oxidation factor		Emissions data	GHGs (metric tonnes CO_2e)					GHGs (metric tonnes CO_2e)					Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
			Sub-category	Activity	Description		Amount	Unit	EF unit	Default	Override			Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Default	Override		CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	AD			
Add	I.7.1	1	**Emissions from fugitive emissions within the city boundary**			NO																												I.7.1 does not occur		

I.8 FUGITIVE EMISSIONS FROM OIL AND NATURAL GAS SYSTEMS

	GPC ref No.	Scope	GHG Emissions Source			Notation keys	Activity data		Activity data unit converter			Gas(es)	Emission factor	Emission factor						Oxidation factor		Emissions data	GHGs (metric tonnes CO_2e)					GHGs (metric tonnes CO_2e)					Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
			Sub-category	Activity	Description		Amount	Unit	EF unit	Default	Override			Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Default	Override		CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	AD			
1	I.8.1	1	**Emissions from fugitive emissions within the city boundary**																																	
	I.8.1	1	Gas	Distribution (1.B.2.b.iii.5)	Fugitive natural gas from distribution		1,472,552,663	m³				CO2, CH4	Please select	tCO2e/	0	0	0	0	0	1		✓	75	40,495				75	40495	-	40570	-	M	Total natural gas use activity data multiplied by emission factor provided in CIRIS Fugitive gas calculation tool	Center Point Energy natural gas use	Data provided by utility - assumed to have moderate quality assurance conducted by City of Houston

II TRANSPORTATION

Use this tab to record activity and emissions data for Transportation sources. The "Add" function allows you to select the required number of rows for each section. Emission factors should be recorded in the 'Emission factors' tab. Use the 'Activity data unit converter' if activity data units do not match the emission factor selected. Notation keys should be used for each section where no data is reported. Some BASIC and all BASIC+ activities been pre-assigned the notation keys NO and NE respectively. Please delete these and the explanation if you have activity or emissions data for these activities.

II.1 ON-ROAD TRANSPORTATION

Enter activity data | Select an emission factor — OR — Enter emissions data

	GPC ref No.	Scope	GHG Emissions Source: Method	Activity	Description	Notation keys	Activity data: Amount	Unit	Activity data unit converter: EF unit	Default	Override	Gas(es)	Emission factor	Emission factor: Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Oxidation factor: Default	Override	Emissions data	GHGs (metric tonnes CO_2e): CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	GHGs (metric tonnes CO_2e): CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Data Quality: AD	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
25	II.1.1	1	Emissions from fuel combustion on-road transportation occurring in the city																																	
	II.1.1	1	Geographic / Territorial	Motor gasoline (petrol)	Motorcycles		23,568,893	miles				CO2, CH4, N2O	EF_gas motorcycles	tCO2e/mile	0.000378272	9.25041E-07	2.35822E-06			1								8915	22	56	8993	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Motor gasoline (petrol)	Passenger cars		23,356,301,945	miles				CO2, CH4, N2O	EF_gas passenger cars	tCO2e/mile	0.000367809	1.82342E-07	2.66852E-06			1								8590661	4259	62327	8657247	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Motor gasoline (petrol)	Passenger trucks		5,793,729,544	miles				CO2, CH4, N2O	EF_gas passenger trucks	tCO2e/mile	0.000507791	5.06834E-07	6.65435E-06			1								2942002	2936	38554	2983492	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Motor gasoline (petrol)	Light commercial trucks		1,423,205,463	miles				CO2, CH4, N2O	EF_gas light commercial	tCO2e/mile	0.000506052	6.79655E-07	8.9511E-06			1								720217	967	12739	733923	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Motor gasoline (petrol)	School buses		599,875	miles				CO2, CH4, N2O	EF_gas school buses	tCO2e/mile	0.000973697	7.74781E-06	3.80536E-05			1								584	5	23	612	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Motor gasoline (petrol)	Refuse trucks		13,545,792	miles				CO2, CH4, N2O	EF_gas refuse trucks	tCO2e/mile	0.001790348	5.6749E-07	4.15222E-06			1								24252	8	56	24316	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Motor gasoline (petrol)	Single unit short-haul trucks		255,664,881	miles				CO2, CH4, N2O	EF_gas single unit short-haul	tCO2e/mile	0.001061224	5.43712E-07	9.29524E-06			1								271318	139	2376	273833	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Motor gasoline (petrol)	Single unit long-haul trucks		42,123,933	miles				CO2, CH4, N2O	EF_gas single unit long-haul	tCO2e/mile	0.000988756	4.57585E-07	6.84012E-06			1								41650	19	288	41958	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Motor gasoline (petrol)	Motor homes		10,650,660	miles				CO2, CH4, N2O	EF_gas motor homes	tCO2e/mile	0.00105919	1.17138E-06	7.03775E-06			1								11281	12	75	11369	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Motor gasoline (petrol)	Combination short-haul trucks		38,861,150	miles				CO2, CH4, N2O	EF_gas combination short-	tCO2e/mile	0.00177864	1.02875E-06	9.75511E-06			1								69120	40	379	69539	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Diesel oil	Passenger cars		164,655,929	miles				CO2, CH4, N2O	EF_diesel passenger cars	tCO2e/mile	0.000395649	3.91686E-07	1.50063E-07			1								65146	64	25	65235	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Diesel oil	Passenger trucks		100,126,489	miles				CO2, CH4, N2O	EF_diesel passenger trucks	tCO2e/mile	0.000723418	7.68799E-07	6.73247E-07			1								72433	77	67	72578	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Diesel oil	Light commercial trucks		78,081,585	miles				CO2, CH4, N2O	EF_diesel light commercial	tCO2e/mile	0.000744174	9.84683E-07	1.07998E-06			1								58106	77	84	58268	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Diesel oil	Intercity buses		10,033,333	miles				CO2, CH4, N2O	EF_diesel intercity buses	tCO2e/mile	0.001871302	5.49805E-07	9.25778E-07			1								18775	6	9	18790	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Diesel oil	Transit buses		19,937,091	miles				CO2, CH4, N2O	EF_diesel transit buses	tCO2e/mile	0.001405445	5.30453E-07	6.72024E-07			1								28020	11	13	28044	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Diesel oil	School buses		54,792,906	miles				CO2, CH4, N2O	EF_diesel school buses	tCO2e/mile	0.000955853	5.26674E-07	7.19496E-07			1								52374	29	39	52442	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Diesel oil	Refuse trucks		22,627,898	miles				CO2, CH4, N2O	EF_diesel refuse trucks	tCO2e/mile	0.001904887	7.7383E-07	6.81599E-07			1								43104	18	15	43137	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Diesel oil	Single unit short-haul trucks		427,914,966	miles				CO2, CH4, N2O	EF_diesel single unit short-	tCO2e/mile	0.001092149	1.13402E-06	9.25316E-07			1								467347	485	396	468228	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Diesel oil	Single unit long-haul trucks		70,460,042	miles				CO2, CH4, N2O	EF_diesel single unit long-	tCO2e/mile	0.001021688	1.11191E-06	8.22433E-07			1								71988	78	58	72124	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Diesel oil	Motor homes		17,831,483	miles				CO2, CH4, N2O	EF_diesel single motor	tCO2e/mile	0.001107052	7.57506E-07	6.37593E-07			1								19740	14	11	19765	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Diesel oil	Combination short-haul trucks		478,797,583	miles				CO2, CH4, N2O	EF_diesel combination short-	tCO2e/mile	0.00191	8.53211E-07	6.76876E-07			1								914503	409	324	915236	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1	Geographic / Territorial	Diesel oil	Combination long-haul trucks		638,055,438	miles				CO2, CH4, N2O	EF_diesel combination long-	tCO2e/mile	0.002055346	3.02994E-06	6.21807E-07			1								1311424	1933	397	1313754	-	H	In-boundary activity data multiplied by distance-based emission factor	HGAC, Texas A&M Transportation Institute (TTI)	
	II.1.1	1						Please select				Please select	Please select	tCO2e/	0	0	0	0	0														Please select		Please select	
	II.1.1	1						Please select				Please select	Please select	tCO2e/	0	0	0	0	0														Please select		Please select	
Add	II.1.2	2	Emissions from grid-supplied energy consumed in the city for on-road transportation			IE																												II.1.2 are assumed to be included in the Stationary Energy sector		
1	II.1.3	3	Emissions from transboundary journeys occurring outside the city, and T&D losses from grid-supplied energy consumption			NE																												II.1.3 has not been estimated; not required for BASIC		

II.2 RAILWAYS

	GPC ref No.	Scope	GHG Emissions Source: Method	Activity	Description	Notation keys	Activity data: Amount	Unit	Activity data unit converter: EF unit	Default	Override	Gas(es)	Emission factor	Emission factor: Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Oxidation factor: Default	Override	Emissions data	GHGs (metric tonnes CO_2e): CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	GHGs (metric tonnes CO_2e): CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Data Quality: AD	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
5	II.2.1	1	Emissions from fuel combustion for railway transportation occuring in the city																																	
	II.2.1	1	Fuel sales approach	Diesel oil	Freight Rail - Switch Yard		3,866,510	gal (US)				CO2, CH4, N2O	EF_locomotive diesel	tCO2e/gallon	0.01021	0.00002	0.00007748			1								39477	77	300	39854	-	M	Activity data multiplied by emission factor. The activity data is for all of Harris County - this was conservatively assumed to represent all switchyeard within Houston limits.	Freight rail activity data	Activity data provided by email to City of Houston from Heather Perez at Eastern Research Group - unknown data quality assurance performed by ERG.
	II.2.1	1	Resident activity	Electricity	Passenger miles - commuter rail		33,086,541	miles				CO2, CH4, N2O	EF_commuter rail	tCO2e/passenger mile	0.000169	2.125E-07	1.0132E-06			1								5592	7	34	5632	-	M	Activity data multiplied by emission factor. Emission factor is from U.S. EPA, and is representative of all commuter rail in the U.S. - essentially a weighted average. As such, emissions from this source are not dependant of specific energy source	Commuter rail activity data	Uncertain quality assurance completed on activity data.
	II.2.1	1	Resident activity	Diesel oil	Passenger miles - Amtrak		559,606	miles				CO2, CH4, N2O	EF_Amtrak	tCO2e/passenger mile	0.000136	2.075E-07	0.000000894			1								76.11	0.12	0.50	76.72	-	H	Activity data (passenger miles) calculated by multiplying total passengers by miles of track within city limits. Activity data multiplied by emission factor to calculate GHG emissions	Total passenger miles	
	II.2.1	1	Fuel sales approach	Diesel oil	Freight Rail - line haul		15,705,903	gal (US)				CO2, CH4, N2O	EF_locomotive diesel	tCO2e/gallon	0.01021	0.00002	0.00007748			1								160,357	314	1,217	161,888	-	M	Activity data multiplied by emission factor. The activity data is for all of Harris County - this was conservatively assumed to represent all switchyeard within Houston limits.	Freight rail activity data	Activity data provided by email to City of Houston from Heather Perez at Eastern Research Group - unknown data quality assurance performed by ERG.
	II.2.1	1	Please select	Please select				Please select				Please select	Please select	tCO2e/	0	0	0	0	0														Please select		Please select	
1	II.2.2	2	Emissions from grid-supplied energy consumed in the city for railways			IE																												Emissions from II.2.2 are included in Stationary Energy 1.2.2.		
1	II.2.3	3	Emissions from transboundary journeys occurring outside the city, and T&D losses from grid-supplied energy consumption			NE																												II.2.3 has not been estimated; not required for BASIC		

II.3 WATERBORNE NAVIGATION

	GPC ref No.	Scope	GHG Emissions Source: Method	Activity	Description	Notation keys	Activity data: Amount	Unit	Activity data unit converter: EF unit	Default	Override	Gas(es)	Emission factor	Emission factor: Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Oxidation factor: Default	Override	Emissions data	GHGs (metric tonnes CO_2e): CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	GHGs (metric tonnes CO_2e): CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Data Quality: AD	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
Add	II.3.1	1	Emissions from fuel combustion for waterborne navigation occurring in the city			NO																												II.3.1 not occurring; no waterborne activity within city boundary		
Add	II.3.2	2	Emissions from grid-supplied energy consumed in the city for waterborne navigation			NO																												II.2.3 does not occur		
Add	II.3.3	3	Emissions from transboundary journeys occurring outside the city, and T&D losses from grid-supplied energy consumption			NE																												II.3.3 has not been estimated; not required for BASIC		

II.4 AVIATION

	GPC ref No.	Scope	GHG Emissions Source: Method	Activity	Description	Notation keys	Activity data: Amount	Unit	Activity data unit converter: EF unit	Default	Override	Gas(es)	Emission factor	Emission factor: Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Oxidation factor: Default	Override	Emissions data	GHGs (metric tonnes CO_2e): CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	GHGs (metric tonnes CO_2e): CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Data Quality: AD	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
2	II.4.1	1	Emissions from fuel combustion for aviation occurring in the city																																	
	II.4.1	1	Fuel sales approach	Jet kerosene	Jet fuel used for Houston Police helicopters		61,821	gal (US)				CO2, CH4, N2O	EF_jet kerosene	tCO2e/gallon	0.00975	0.00001025	0.00002384			1								603	1	1	605	-	M	Activity data multiplied by emission factor	Aviation activity data	Uncertain quality assurance completed on activity data by City of Houston
	II.4.1	1	Fuel sales approach	Aviation gasoline	Aviation gasoline used for Houston Police		5,872	gal (US)				CO2, CH4, N2O	EF_aviation gasoline	tCO2e/gallon	0.00831	0.000009	0.00002086			1								49	0	0	49	-	M	Activity data multiplied by emission factor	Aviation activity data	Uncertain quality assurance completed on activity data by City of Houston
Add	II.4.2	2	Emissions from grid-supplied energy consumed in the city for aviation			NO																												II.4.2 does not occur		
1	II.4.3	3	Emissions from transboundary journeys occurring outside the city, and T&D losses from grid-supplied energy consumption			NE																												II.4.3 has not been estimated; not required for BASIC		

II.5 OFF-ROAD TRANSPORTATION

	GPC ref No.	Scope	GHG Emissions Source: Method	Activity	Description	Notation keys	Activity data: Amount	Unit	Activity data unit converter: EF unit	Default	Override	Gas(es)	Emission factor	Emission factor: Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Oxidation factor: Default	Override	Emissions data	GHGs (metric tonnes CO_2e): CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	GHGs (metric tonnes CO_2e): CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$	Data Quality: AD	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
Add	II.5.1	1	Emissions from fuel combustion for off-road transportation occurring in the city			NO																												II.5.1 negligible		
Add	II.5.2	2	Emissions from grid-supplied energy consumed in the city for off-road transportation			NO																												II.5.2 does not occur		
Add	II.5.3	3	Emissions from transboundary journeys occurring outside the city, and T&D losses from grid-supplied energy consumption			NE																												II.5.3 has not been estimated; not required for BASIC		

III WASTE

Use this tab to record activity and emissions data for Waste sources. The "Add" function allows you to select the required number of rows for each section. Emission factors should be recorded in the 'Emission factors' tab. Use the 'Activity data unit converter' if activity data units do not match the emission factor selected. Notation keys should be used for each section where no data is reported. Note, all sections must be completed for a BASIC inventory.

III.1 SOLID WASTE DISPOSAL

Enter activity data | Select an emission factor | OR | Enter emissions data

	GPC ref No.	Scope	GHG Emissions Source: Treatment activity	GHG Emissions Source: Type of waste	GHG Emissions Source: Description	Notation keys	Activity data: Amount	Activity data: Unit	Activity data unit converter: EF unit	Activity data unit converter: Default	Activity data unit converter: Override	Gas(es)	Emission factor	Emission factor: Units	Emission factor: CO_2	Emission factor: CH_4	Emission factor: N_2O	Emission factor: Total tCO_2e	Emission factor: $CO_2(b)$	Emissions data	GHGs (metric tonnes CO_2e): CO_2	GHGs (metric tonnes CO_2e): CH_4	GHGs (metric tonnes CO_2e): N_2O	GHGs (metric tonnes CO_2e): Total tCO_2e	GHGs (metric tonnes CO_2e): $CO_2(b)$	GHGs (metric tonnes CO_2e): CO_2	GHGs (metric tonnes CO_2e): CH_4	GHGs (metric tonnes CO_2e): N_2O	GHGs (metric tonnes CO_2e): Total tCO_2e	GHGs (metric tonnes CO_2e): $CO_2(b)$	Data Quality: AD	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
2	III.1.1	1	**Emissions from solid waste generated in the city and disposed in landfills or open dumps within the city**																														
	III.1.1	1	Landfill sites - Methane commitment	Municipal Solid Waste - McCarty Road	Residential and commercialsolid waste sent to landfill_direct release		110,223	tonne				CH4	Please select	tCO2e/	0	0	0	0	0	✓		25,415		3,417		-	25415	-	25415	3417	M	Activity data provided by City of Houston, composition data MSWfs gathered from national EPA report (see "Solid Waste Disposal" sheet for details). GHG emissions calculated using Solid Waste Disposal calculator in CIRIS	Total solid waste generation	MSW composition are national average
	III.1.1	1	Landfill sites - Methane commitment	Municipal Solid Waste - McCarty Road	Residential and commercial solid waste sent to landfill - LFG combusted		110,223	tonne				CH4	Please select	tCO2e/	0	0	0	0	0	✓		6,001		8,361		-	4001	-	4001	8361	M	Activity data provided by City of Houston, composition data MSWfs gathered from national EPA report (see "Solid Waste Disposal" sheet for details). GHG emissions calculated using Solid Waste Disposal calculator in CIRIS	Total solid waste generation	MSW composition are national average
2	III.1.2	2	**Emissions from solid waste generated in the city but disposed in landfills or open dumps outside the city**																														
	III.1.2	2	Landfill sites - Methane commitment	Municipal solid waste	Residential and commercial solid waste sent to landfill - direct release		1,989,919	tonne				CH4	Please select	tCO2e/	0	0	0	0	0	✓		658,836		61,688		-	658836	-	658836	61688	M	Activity data calculated from information provided by City of Houston, per capita waste generation from TCEQ for 2015 for Houston-Galveston-Area Council region (see "Solid Waste Disposal" sheet for details). GHG emissions calculated using Solid Waste Disposal calculator in CIRIS	Total solid waste generation	Activity data calculated from modelled data from regional per capita generation estimate, MSW composition are national average
	III.1.2	2	Landfill sites - Methane commitment	Municipal solid waste	Residential and commercial solid waste sent to landfill - LFG combusted		1,989,919	tonne				CH4	Please select	tCO2e/	0	0	0	0	0	✓		72,224		150,948		-	72224	-	72224	150948	M	Activity data calculated from information provided by City of Houston, per capita waste generation from TCEQ for 2015 for Houston-Galveston-Area Council region (see "Solid Waste Disposal" sheet for details). GHG emissions calculated using Solid Waste Disposal calculator in CIRIS	Total solid waste generation	Activity data calculated from modelled data from regional per capita generation estimate, MSW composition are national average
2	III.1.3	1	**Emissions from waste generated outside the city and disposed in landfills or open dumps within the city**																														
	III.1.3	1	Landfill sites - Methane commitment	Solid Waste	Residential and Commercial solid waste sent to landfill - direct release		1,809,216	tonne				CH4	Please select	tCO2e/	0	0	0	0	0	✓		617,192		56,089		-	617192	-	617192	56089	M	Activity data calculated from EPA Flight database and information from City of Houston (see "Solid Waste Disposal" sheet for details). GHG emissions calculated using Solid Waste Disposal calculator in CIRIS	U.S. EPA FLIGHT tool	Activity data calculated from modelled data from regional per capita generation estimate, MSW composition are national average
	III.1.3	1	Landfill sites - Methane commitment	Solid Waste	Residential and Commercial solid waste sent to landfill - LFG combusted		1,809,216	tonne				CH4	Please select	tCO2e/	0	0	0	0	0	✓		65,669		137,248		-	65669	-	65669	137248	M	Activity data provided calculated from EPA Flight database and information from City of Houston (see "Solid Waste Disposal" sheet for details). GHG emissions calculated using Solid Waste Disposal calculator in CIRIS	U.S. EPA FLIGHT tool	Activity data calculated from modelled data from regional per capita generation estimate, MSW composition are national average

III.2 BIOLOGICAL TREATMENT OF WASTE

	GPC ref No.	Scope	GHG Emissions Source: Treatment activity	GHG Emissions Source: Type of waste	GHG Emissions Source: Description	Notation keys	Activity data: Amount	Activity data: Unit	Activity data unit converter: EF unit	Activity data unit converter: Default	Activity data unit converter: Override	Gas(es)	Emission factor	Emission factor: Units	Emission factor: CO_2	Emission factor: CH_4	Emission factor: N_2O	Emission factor: Total tCO_2e	Emission factor: $CO_2(b)$	Emissions data	GHGs (metric tonnes CO_2e): CO_2	GHGs (metric tonnes CO_2e): CH_4	GHGs (metric tonnes CO_2e): N_2O	GHGs (metric tonnes CO_2e): Total tCO_2e	GHGs (metric tonnes CO_2e): $CO_2(b)$	GHGs (metric tonnes CO_2e): CO_2	GHGs (metric tonnes CO_2e): CH_4	GHGs (metric tonnes CO_2e): N_2O	GHGs (metric tonnes CO_2e): Total tCO_2e	GHGs (metric tonnes CO_2e): $CO_2(b)$	Data Quality: AD	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
Add	III.2.1	1	**Emissions from solid waste generated in the city that is treated biologically in the city**			NO																											
1	III.2.2	3	**Emissions from solid waste generated in the city but treated biologically outside of the city**																														
	III.2.2	3	Composting	All organic waste	Total organic waste diverted from landfill		236,266	tonne				CH4, N2O	Please select	tCO2e/	0	0	0	0	0	✓		33,627	16,898		-	29627	16898	49524	-	M	Activity data calculated using total solid waste generated (per capita waste generation multiplied by population), multiplied by the composting rate provide by the City of Houston (20% total diversion - 11% recycling = 9% composted). See the "Solid Waste Disposal" sheet for calculation of activity data. Emissions are calculated using the Biological treatment calculator in CIRIS	Total solid waste generation	Activity data modeled based on regional per capita generation estimate.
Add	III.2.3	1	**Emissions from waste generated outside the city boundary but treated in the city**			NO																											

III.3 INCINERATION AND OPEN BURNING

	GPC ref No.	Scope	GHG Emissions Source: Treatment activity	GHG Emissions Source: Type of waste	GHG Emissions Source: Description	Notation keys	Activity data: Amount	Activity data: Unit	Activity data unit converter: EF unit	Activity data unit converter: Default	Activity data unit converter: Override	Gas(es)	Emission factor	Emission factor: Units	Emission factor: CO_2	Emission factor: CH_4	Emission factor: N_2O	Emission factor: Total tCO_2e	Emission factor: $CO_2(b)$	Emissions data	GHGs (metric tonnes CO_2e): CO_2	GHGs (metric tonnes CO_2e): CH_4	GHGs (metric tonnes CO_2e): N_2O	GHGs (metric tonnes CO_2e): Total tCO_2e	GHGs (metric tonnes CO_2e): $CO_2(b)$	GHGs (metric tonnes CO_2e): CO_2	GHGs (metric tonnes CO_2e): CH_4	GHGs (metric tonnes CO_2e): N_2O	GHGs (metric tonnes CO_2e): Total tCO_2e	GHGs (metric tonnes CO_2e): $CO_2(b)$	Data Quality: AD	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
Add	III.3.1	1	**Emissions from waste generated and treated within the city**			NO																											
Add	III.3.2	3	**Emissions from waste generated within but treated outside of the city**			NO																											
Add	III.3.3	1	**Emissions from waste generated outside the city boundary but treated within the city**			NO																											

III.4 WASTEWATER TREATMENT AND DISCHARGE

	GPC ref No.	Scope	GHG Emissions Source: Treatment activity	GHG Emissions Source: Type of waste	GHG Emissions Source: Description	Notation keys	Activity data: Amount	Activity data: Unit	Activity data unit converter: EF unit	Activity data unit converter: Default	Activity data unit converter: Override	Gas(es)	Emission factor	Emission factor: Units	Emission factor: CO_2	Emission factor: CH_4	Emission factor: N_2O	Emission factor: Total tCO_2e	Emission factor: $CO_2(b)$	Emissions data	GHGs (metric tonnes CO_2e): CO_2	GHGs (metric tonnes CO_2e): CH_4	GHGs (metric tonnes CO_2e): N_2O	GHGs (metric tonnes CO_2e): Total tCO_2e	GHGs (metric tonnes CO_2e): $CO_2(b)$	GHGs (metric tonnes CO_2e): CO_2	GHGs (metric tonnes CO_2e): CH_4	GHGs (metric tonnes CO_2e): N_2O	GHGs (metric tonnes CO_2e): Total tCO_2e	GHGs (metric tonnes CO_2e): $CO_2(b)$	Data Quality: AD	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
2	III.4.1	1	**Emissions from wastewater generated and treated within the city**																														
	III.4.1	1	Domestic wastewater (4.D.1)	Municipal wastewater from WWTPs								CH4, N2O								✓		158,394	58,956		-	158394	58950	217344	-	M	Calculated using wastewater calculator in CIRIS, based on population, climate, use of surface disposals.	Total population	
	III.4.1	1	Industrial wastewater (4.D.2)	Wastewater treated by industrial WWTPs		NO						Please select	Please select	tCO2e/	0	0	0	0	0												Please select	Based on 2007 inventory data, all industrial WWTPs in the city boundary are well-managed aerobic plants. According to IPCC 2006 guidelines methane and N2O emissions from these plants are negligible.	Please select	
Add	III.4.2	3	**Emissions from wastewater generated within but treated outside of the city**			NO																											
Add	III.4.3	1	**Emissions from wastewater generated outside the city boundary but treated within the city**			NO																											

CIRIS	Introduction	Set-up	Inventory	Calculators	Results	Notes
	Stationary	Transportation	Waste	IPPU	AFOLU	Scope 3

IV INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)

Use this tab to record activity and emissions data for IPPU sources. This is required for BASIC+ only. The "Add" function allows you to select the required number of rows for each section. Emission factors should be recorded in the 'IPPU emission factors' tab. Use the 'Activity data unit converter' if activity data units do not match the emission factor selected. Notation keys should be used for each section where no data is reported. All activities have been pre-assigned the notation NE. Please delete these and the explanations if you have activity or emissions data for these activities.

IV.1 INDUSTRIAL PROCESSES

	GPC ref No.	Scope	GHG Emissions Source			Notation keys	Activity data		Activity data unit converter			Gas(es)	Emission factor
			Industry	Industrial process	Description		Amount	Unit	EF unit	Default	Override		
Add	IV.1	1	Emissions from industrial processes occurring in the city boundary			NE							

GPC ref No.	Emission factor																				
	Units	CO_2	CH_4	N_2O	CF4	C2F6	HFC-23	HFC-32	HFC-41	HFC-125	HFC-134	HFC-134a	HFC-143	HFC-143a	HFC-152a	HFC-227ea	HFC-236fa	HFC-245ca	SF_6	NF_3	Total tCO_2e	CO_2(b)
IV.1																						

GPC ref No.	Emissions data	GHGs (metric tonnes CO_2e)									GHGs (metric tonnes CO_2e)									Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
		CO_2	CH_4	N_2O	PFC	HFC	SF_6	NF_3	Total tCO_2e	CO_2(b)	CO_2	CH_4	N_2O	PFC	HFC	SF_6	NF_3	Total tCO_2e	CO_2(b)	AD			
IV.1																					IV.1 has not been estimated; not required for BASIC		

IV.2 PRODUCT USE

	GPC ref No.	Scope	GHG Emissions Source			Notation keys	Activity data		Activity data unit converter			Gas(es)	Emission factor
			Industry	Product use	Description		Amount	Unit	EF unit	Default	Override		
Add	IV.2	1	Emissions from product use occurring within the city boundary			NE							

GPC ref No.	Emission factor																				
	Units	CO_2	CH_4	N_2O	CF4	C2F6	HFC-23	HFC-32	HFC-41	HFC-125	HFC-134	HFC-134a	HFC-143	HFC-143a	HFC-152a	HFC-227ea	HFC-236fa	HFC-245ca	SF_6	NF_3	Total tCO_2e	CO_2(b)
IV.2																						

GPC ref No.	Emissions data	GHGs (metric tonnes CO_2e)									GHGs (metric tonnes CO_2e)									Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
		CO_2	CH_4	N_2O	PFC	HFC	SF_6	NF_3	Total tCO_2e	CO_2(b)	CO_2	CH_4	N_2O	PFC	HFC	SF_6	NF_3	Total tCO_2e	CO_2(b)	AD			
IV.2																					IV.2 has not been estimated; not required for BASIC		

V. AFOLU

Use this tab to record activity and emissions data for AFOLU sources. This is required for BASIC+ only. The "Add" function allows you to select the required number of rows for each section. Emission factors should be recorded in the 'Emission factors' tab. Use the 'Activity data unit converter' if activity data units do not match the emission factor selected. Notation keys should be used for each section where no data is reported. All activities have been pre-assigned the notation NE. Please delete these and the explanations if you have activity or emissions data for these activities.

V.1 LIVESTOCK

	GPC ref No.	Scope	GHG Emissions Source		Notation keys	Activity data		Activity data unit converter			Gas(es)	Emission factor	Emission factor						Emissions data	GHGs (metric tonnes CO_2e)					GHGs (metric tonnes CO_2e)					Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
			Activity	Description		Amount	Unit	EF unit	Default	Override			Units	CO_2	CH_4	N_2O	Total tCO_2e	CO_2(b)		CO_2	CH_4	N_2O	Total tCO_2e	CO_2(b)	CO_2	CH_4	N_2O	Total tCO_2e	CO_2(b)	AD			
Add	V.1	1	**Emissions from livestock**		NE																									V.1 has not been estimated; not required for BASIC		

V.2 LAND

	GPC ref No.	Scope	GHG Emissions Source		Notation keys	Activity data		Activity data unit converter			Gas(es)	Emission factor	Emission factor						Emissions data	GHGs (metric tonnes CO_2e)					GHGs (metric tonnes CO_2e)					Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
			Activity	Description		Amount	Unit	EF unit	Default	Override			Units	CO_2	CH_4	N_2O	Total tCO_2e	CO_2(b)		CO_2	CH_4	N_2O	Total tCO_2e	CO_2(b)	CO_2	CH_4	N_2O	Total tCO_2e	CO_2(b)	AD			
Add	V.2	1	**Emissions from land**		NE																									V.2 has not been estimated; not required for BASIC		

V.3 AGGREGATE SOURCES

	GPC ref No.	Scope	GHG Emissions Source		Notation keys	Activity data		Activity data unit converter			Gas(es)	Emission factor	Emission factor						Emissions data	GHGs (metric tonnes CO2e)					GHGs (metric tonnes CO2e)					Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
			Activity	Description		Amount	Unit	EF unit	Default	Override			Units	CO_2	CH_4	N_2O	Total tCO_2e	CO_2(b)		CO_2	CH_4	N_2O	Total tCO_2e	CO_2(b)	CO_2	CH_4	N_2O	Total tCO_2e	CO_2(b)	AD			
Add	V.3	1	**Emissions from aggregate sources and non-CO2 emission sources on land**		NE																									V.3 has not been estimated; not required for BASIC		

VI. OTHER SCOPE 3

Use this tab to record activity and emissions data for Other scope 3 sources. This sector is optional. The "Add" function allows you to select the required number of rows for each sector. Emission factors should be recorded in the 'Emission factors' tab. Use the 'Activity data unit converter' if activity data units do not match the emission factor selected. The notation key NE has been used for this sector. Please delete this and the explanation if you have activity or emissions data for this sector.

VI.1 OTHER SCOPE 3

GPC ref No.	Scope	GHG Emissions Source		Notation key	Activity data		Activity data unit converter			Gas(es)	Emission factor	Emission factor					Emissions data	GHGs (metric tonnes CO2e)					GHGs (metric tonnes CO2e)					Data Quality	Description of method(s) used or explanation for using notation key(s)	Source	Data quality explanation (optional)
		Activity	Description		Amount	Unit	EF unit	Default	Override			Units	CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$		CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$		CO_2	CH_4	N_2O	Total tCO_2e	$CO_2(b)$				
I.1		VI.1	3	Other Scope 3		NE																								VI.1 has not been estimated; not required for BASIC		

FUGITIVE EMISSIONS FROM GAS DISTRIBUTION CALCULATOR (I.8)

This tool has been designed to help cities estimate fugitive emissions from the distribution of gas to end users via a low pressure distribution system within cities.
All default values and their sources can be found in the Data Table section below.

1. Instructions

1.	Grey cells contain formulas and default values based on IPCC 2006 Guidelines for National Greenhouse Gas Inventories. Please do not modify these.
2.	White cells, in the calculation table, are for user-entered data ('override'). Where applicable, these can be used to override the default data in the grey cells.
3.	All red cells must be completed; select "Development status" in the City information box and enter "Activity data" and select the relevant "Unit" in the Calculation table

2. City information

City information	Default	
City	Houston	
Country	USA	
Development status	Developed	< Select from list
Global Warming Potential	4AR	

3. Emissions summary

Source	Total tCO_2e		
	CO_2	CH_4	Total
Fugitive emissions	75	40,495	40,570

4. Carbon dioxide (CO_2) and methane (CH_4) emissions from gas distribution

Formulas

CO_2 emissions = Σ (V * EF)	
V	= Volume of utility sales, m3
EF	= Emission factor, tCO2/m3

CH_4 emissions = Σ (V * EF)	
V	= Volume of utility sales, m3
EF	= Emission factor, tCH4/m3

Calculation table

Activity Data	Unit	Net-calorific value			Density, kg/m^3		Conversions		Emission factors, t/m^3				CO_2	CH_4		Total
		TJ/Gg		kWh/tonne[2]			kWh	m^3	CO_2		CH_4		tCO_2	tCH_4	tCO_2e	tCO_2e
Value	Value	Default[1]	Override	Value	Default[3]	Override	Value	Value	Default[4]	Override	Default[4]	Override	Value	Value	Value	Value
1,472,552,663	m3	48		13,333	0.70			1472552663	0.000000051		0.0000011		75	1619.8079	40495	40570
		48		13,333	0.70											
		48		13,333	0.70											
		48		13,333	0.70											
		48		13,333	0.70											
												Total	75	1620	40495	40570

[1] Net Calorific Values for fuels, Table 1.2, Volume 2 Chapter 1, IPCC 2006 Guidelines http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf
[2] The conversion from GJ to kWh is 277.78 (See Conversion factors tab)
[3] Source: WRI/WBCSD stationary combustion calculation tool version 3.3. Note: Density value is highly sensitive to changes in temperature and pressure. Value indicated is based on room temperature and standard atmospheric pressure.
[4] Default emission factors from Table 4.2.4 for developed countries and Table 4.2.5 for developing countries, Chapter 4, IPCC 2006

DATA TABLE

IPCC 2006 Volume 2 Chapter 4 Fugitive Emissions Table 4.2.4 and 4.2.5: Tier 1 Emission Factors for Fugitive Emissions From Oil and Gas Operations in Developed Countries/ Developing Countries and Countries with Economies in Transition

IPCC Code 1.B.2.b.iii.5	CH_4			CO_2		
	Range	Value	Uncertainty	Range	Value	Uncertainty
Gg per 1,000,000 m3 utility sales						
Developed		1.10E-03	-20 to +500%		5.10E-05	-20 to +500%
Developing	1.1E-03 to 2.5E-03	0.0018	-20 to +500%	5.1E-05 to 1.4E-04	0.00009575	-20 to +500%
Tonnes per m3 utility sales						
Developed		1.10E-06	-20 to +500%		5.10E-08	-20 to +500%
Developing		1.80E-06	-20 to +500%		9.58E-08	-20 to +500%

Note - Values for Developing countries have been derived from the average of the range. Cities are advised to replace these default values with country-specific values wherever possible

CIRIS

Introduction	Set-up	Inventory	Calculators	Results	Notes
Fugitive emissions	Solid waste disposal	Biological treatment	Incineration	Wastewater	

SOLID WASTE DISPOSAL EMISSIONS CALCULATOR (III.1)

This tool has been designed to help cities estimate carbon dioxide (CO_2) and methane (CH_4) emissions from solid waste disposal using the methane commitment methodology.
All default values and their sources can be found in the Data Table section below.

1. Instructions

1.	Grey cells contain formulas and default values based on IPCC 2006 Guidelines for National Greenhouse Gas Inventories. Please do not modify these.
2.	White cells, in the calculation tables, are for user-entered data ('override'). Where applicable, these can be used to override the default data in the grey cells.
3.	All red cells in the City information section must be completed for the tool to estimate emissions
4.	This tool uses the Methane Commitment method (MC) as recommened in the GPC. For cities that prefer to use the First Order Decay method (FOD), the GPC recommends the IPCC Waste Tool

2. City information

City information	Default	
City	Houston	
Country	USA	
Region	America	< Select from list
Sub-region	North America	< Select from list
Total waste deposited in landfill metric tonnes	1,809,316	< Enter amount
Landfill gas collection efficiency	85%	< Enter percentage
Proportion of landfill gas collected used as ener	75%	< Enter percentage
Management of l	Managed	< Select from list
Global Warming Potential	4AR	

>>> For landfill gas collection efficiencies, assume:
- 0% for landfill without active gas collection
- 60% for landfill with daily soil cover and active gas collections
- 75% for landfill with intermediate soil cover and active gas collection
- 95% for landfill with final cover and active gas collection

In a modern landfill, an average of 85% of the landfill gas will be collected

>>> Managed landfill sites have vent pipes that allow landfill gas to get out of the waste and be collected, burnt or released to the air in a controlled way

3. Emission summary

Source	Total GHGs (metric tonnes CO_2e) CH_4	N_2O	Total	$CO_2(b)$	Sector where emissions sould be reported
Direct release of landfill gas to atmosphere	417,192	Trace	417,192	56,089	Waste
Combustion of landfill gas with energy recovery	197,007	Trace	197,007	411,745	Stationary Energy
Combustion of landfill gas without energy recov	65,669	Trace	65,669	137,248	Waste
Total	679,869	Trace	679,869	605,083	

Activity data calculation:

Population	Solid waste ge	Days per year	Solid waste ge	Total solid wa	metric tons pe	Total waste ge	Total diversio	Total waste se	Composting ra	Total waste composted
2,239,558	7.08	365	2584.2	5787465784	0.0004536	2,625,177	20%	2,100,142	9%	236,266

<-- Activity data for III.2.1

Activity data for III.1.1--> City Waste to McCarty Rd. **110,223** <-- Data from City Waste Dept.

Activity data for III.1.2 --> **1,989,919**

McCarty Rd. Total 1,919,539 https://ghgdata.epa.gov/ghgp/service/facilityDetail/2014?id=1006899&ds=E&et=&popup=true

Activity data for III.1.3 --> Waste Imported from Outside City to McCarty Rd. **1,809,316**

4. Methane generated using methane commitment method (GPC Chapter 8.3.2, Page 92)

Formulas

GPC equation 8.3: Methane commitment estimate for solid waste (adapted)

A =	= MSWx x L0
A	= Methane generated in landfill, measured in metric tonnes
MSW_X	= Mass of solid waste sent to landfill in inventory year, measured in metric tonnes
L_0	= Methane generation potential

GPC equation 8.4: Methane generation potential

L_0	= MCF * DOC * DOCF * F * 16/12
MCF	= Methane correction factor based on type of landfill site for the year of deposition: Managed = 1, Unmanaged (≥5m) = 0.8, Unmanaged (<5m) = 0.4,
DOC	= Degradable organic carbon in year of deposition, fraction (metric tonnes C/metric tonnes waste); GPC equation 8.1
DOC_F	= Fraction of DOC that is ultimately degraded (reflects the fact that some organic carbon does not degrade); assumed equal to 0.6
F	= Fraction of methane in landfill gas generated; assumed equal to 0.5
16/12	= Molecular weight ratio of CH4 and carbon

GPC equation 8.1: Degradable organic carbon (DOC)

DOC	= (0.15 x A) + (0.2 x B) + (0.4 x C) + (0.43 x D) + (0.24 x E) + (0.15 x F)
A	= Fraction of solid waste that is food
B	= Fraction of solid waste that is garden waste and other plant debris
C	= Fraction of solid waste that is paper
D	= Fraction of solid waste that is wood
E	= Fraction of solid waste that is textiles
F	= Fraction of solid waste that is industrial waste
Other	= Fraction of waste that is other; assumed to be zero under IPCC Tier 1 default

Calculation tables

Methane commitment estimate for solid waste sent to landfill (GPC equation 8.3)

Total waste deposited in landfill metric tonnes	Methane generation potential (L_0)	Methane generated (A), tCH_4
Value	Value	Value
1809316	0.068	123,612

Methane generation potential (GPC equation 8.4)

Methane Correction Factor (MCF)		Degradable organic carbon in year of deposition (DOC)	Fraction of DOC that is ultimately degraded (DOC_F)		Fraction of methane in landfill gas (%) (F)		Molecular weight ratio of CH4 and carbon	Methane generation potential, L_0
Default	Override	Value	Default	Override	Default	Override	Default	
1.0		0.1708	0.6		50%		1.3	0.068

Degradable organic carbon (DOC) (GPC equation 8.3, adapted to include additional waste types) <-- Data in Override column are extracted from EPA report: "Advancing Sustainable Materials Management: 2014 Tables and Figures" Table 4

Region	Region	Sub-region	Food waste		Paper / cardboard		Wood		Textiles		Garden and Park waste		Nappies		Rubber / leather		Plastics		Metal		Glass		Other, inert waste		Industrial		Construction and demolition		Clinical waste		Sewage sludge		Fossil liquid waste		Total (must add to 100%)
Value	Value	Value	Default	Override	Default	Override	Default	Override	Default	Override	Default	Override	Default	Override	Default	Override	Default	Override	Default	Override	Default	Override	Default	Override	Default	Override	Default	Override	Default	Override	Default	Override	Default	Override	Check
Composition of M	America	North America	34%	22%	23%	14%	6%	8%	4%	8%	No default >	8%	No default >	0%	1.4%	3%	8.5%	19%	4.6%	9%	6.5%	5%	9.8%	2%	No default >	2%	No default >		No default >		No default >		No default >		100%
DOC			0.15		0.40		0.43		0.24		0.20		0.24		0.39		0.00		0.00		0.00		0.00		0.00		No default >		No default >		No default >		No default >		

5. GHG emissions from landfills without landfill gas collection systems

Formulas

GPC equation 8.3: Methane commitment estimate for solid waste (adapted)

CH_4 (tCO_2e)	= A x (1-CE) x (1-OX) * GWP
A	= CH4 generation from GPC equation 8.3, measured in tonnes CH4
CE	= Collection efficiency
OX	= Oxidation factor; 0.1 for well-managed landfills, 0 for unmanaged landfills

EPA equation 2-3: CO_2 Emissions for Landfills without Gas Collection Systems

$tCO_{2(b)}$	= A x (1-CE) * ((1-F)/F) + OX) * 44/16
A	= CH4 generation from GPC equation 8.3, measured in tonnes CH4
CE	= Collection efficiency
F	= Fraction of methane in landfill gas generated; assumed equal to 0.5
OX	= Oxidation factor; 0.1 for well-managed landfills, 0 for unmanaged landfills
44/16	= Molecular weight ratio of CO2 to CH4

Calculation table

Methane generated (A), tCH_4	Collection efficiency (CE)	Fraction of methane in landfill gas (%) (F)		Oxidation factor (OX)	Molecular weight ratio of CO_2 to CH_4	$tCO_{2(b)}$	Total CH_4 emissions tCH_4	tCO_2e
Value	Value	Default	Override	Value	Value	Value	Value	
123,612	85%	50%		10%	2.75	56,089	16,688	417,192

6. GHG emissions for landfills with landfill gas collection systems

Step 1: Recovered gases

Formulas

EPA equation 2-5: Recovered CH_4 for Landfills with Gas Collection Systems

RCH_4	= A * CE
A	= CH4 generation from GPC equation 8.3, measured in tonnes CH4
CE	= Collection efficiency

EPA equation 2-6: Recovered CO_2 for Landfills with Gas Collection Systems (adapted)

$RCO_{2(b)}$	= A * CE * ((1-F)/F) * 44/16
A	= CH4 generation from GPC equation 8.3, measured in tonnes CH4
CE	= Collection efficiency
F	= Fraction of methane in landfill gas generated; assumed equal to 0.5
44/16	= Molecular weight ratio of CO2 to CH4

Calculation table

CH4 generated (A), tCH_4	Collection efficiency (CE)	Fraction of methane in landfill gas (F), %		Molecular weight ratio of CO_2 to CH_4	RCO_2, tCO_2	RCH_4, tCH_4
Value	Value	Default	Override	Value	Value	Value
123,612	85%	50%		2.75	288,944	105,071

Step 2: CO_2 emissions

Formulas

EPA equation 2-7: Estimate of CO_2 Emissions from Recovery System and Destruction Device

$tCO_{2(b)}$	= RCO2 + (RCH4 * DE * (44/16))
RCO2	= Recovered CO2 from EPA equation 2-5, measured in tonnes CH4
RCH4	= Recovered CH4 from EPA equation 2-6, measured in tonnes CH4
DE	= Destruction efficiency; assumed equal to 0.9
44/16	= Molecular weight ratio of CO2 to CH4

EPA equation 2-8: Estimate of CO_2 Emissions from Unrecovered Landfill Gas

$tCO_{2(b)}$	= ((1-CE)/CE) * RCO2 + (OX * ((1-CE)/CE) *RCH4) *44/16
RCO2	= Recovered CO2 from EPA equation 2-5, measured in tonnes CH4
RCH4	= Recovered CH4 from EPA equation 2-6, measured in tonnes CH4
CE	= Collection efficiency
OX	= Oxidation factor; 0.1 for well-managed landfills, 0 for unmanaged landfills
44/16	= Molecular weight ratio of CO2 to CH4

Calculation table

$RCO_{2(b)}$, tCO_2	RCH_4, tCH_4	Destruction efficiency (DE), %		Collection efficiency (CE)	Oxidation factor (OX)	Molecular weight ratio of CO_2 to CH_4	CO_2 emissions from recovery and burning, $tCO_{2(b)}$	CO_2 emissions from un-recovered gas, tCO_2(b)	Total CO_2 emissions, $tCO_{2(b)}$
Value	Value	Default	Override	Value	Value	Value	Value	Value	Value
288,944	105,071	90%		85%	10%	2.75	548,994	56,089	605,083

Step 3: CH4 emissions

Formulas

EPA equation HH-6: Uncombusted CH4 emissions

CH_4 (tCO_2e)	= RCH4 * (1 - DE) * GWP
RCH4	= Recovered CH4 from EPA equation 2-6, measured in tonnes CH4
DE	= Destruction efficiency; assumed equal to 0.9

EPA equation HH-8: Emissions of uncollected gas from the surface of the landfill

CH_4 (tCO_2e)	= (A - RCH4) * (1 - OX) * GWP
A	= Cubic meters of landfill gas produced per day (m3/day)
RCH4	= Recovered CO2 from EPA equation 2-6, measured in tonnes CH4
OX	= Oxidation factor; 0.1 for well-managed landfills, 0 for unmanaged landfills

Calculation table

CH_4 generated (A), tCH_4	RCH_4, tCH_4	Destruction efficiency (DE), %		Oxidation factor (OX)	Uncombusted emissions tCH_4	tCO_2e	Uncollected emissions tCH_4	tCO_2e
Value	Value	Default	Manual	Value	Value		Value	
123,612	105,071	90%		10%	10,507	262,676	16,688	417,192

DATA TABLES

Formulas

WRI, C40 and ICLEI (2014) Global Protocol for Community-scale GHG emission inventories: www.c40.org/gpc
EPA (2010) GHG Emissions Estimation Methodologies for Biogenic Emissions from Selected Source Categories: https://www3.epa.gov/ttnchie1/efpac/esttools.html

IPCC 2006 Volume 5 Chapter 2: Waste Generation, Composition and Management Data, Table 2.3: MSW composition data by percent - regional defaults

Region	Sub-region	Food waste	Paper /	Wood	Textiles	Rubber /	Plastic	Metal	Glass	Other, inert	Total
Asia	Eastern Asia	26.2%	18.8%	3.5%	3.5%	1.0%	14.3%	2.7%	3.1%	7.4%	80.5%
	uth-Central A	40.3%	11.3%	7.9%	2.5%	0.8%	6.4%	3.8%	3.5%	21.9%	98.4%
	uth-Eastern A	3.5%	12.9%	9.9%	2.7%	0.9%	7.2%	3.3%	4.0%	16.3%	60.7%
	rn Asia & Mid	41.1%	18.0%	9.8%	2.9%	0.6%	6.3%	1.3%	2.2%	5.4%	87.6%
Africa	Eastern Africa	53.9%	7.7%	7.0%	1.7%	1.1%	5.5%	1.8%	2.3%	11.6%	92.6%
	Middle Africa	43.4%	16.8%	6.5%	2.5%		4.5%	3.5%	2.0%	1.5%	80.7%
	Northern Afric	51.1%	16.5%	2.0%	2.5%		4.5%	3.5%	2.0%	1.5%	83.6%
	Southern Afric	23.0%	25.0%	15.0%							63.0%
	Western Afric	40.4%	9.8%	4.4%	1.0%		3.0%	1.0%			59.6%
Europe	Eastern Europ	30.1%	21.8%	7.5%	4.7%	1.4%	6.2%	3.6%	10.0%	14.6%	99.9%
	Northern Europ	23.8%	30.6%	10.0%	2.0%		13.0%	7.0%	8.0%		94.4%
	Southern Europ	36.9%	17.0%	10.6%							64.5%
	Western Europ	24.2%	27.5%	11.0%							62.7%
Oceania	alia and New Z	36.0%	30.0%	24.0%							90.0%
	Rest of Oceani	67.5%	6.0%	2.5%							76.0%
America	North Americ	33.9%	23.2%	6.2%	3.9%	1.4%	8.5%	4.6%	6.5%	9.8%	98.0%
	Central Americ	43.8%	13.7%	13.5%	2.6%	1.0%	6.7%	2.6%	3.7%	12.3%	99.9%
	South Americ	44.9%	17.1%	4.7%	2.6%	0.7%	10.8%	2.9%	3.3%	13.0%	100.0%
	Caribbean	46.9%	17.0%	2.4%	5.1%	1.9%	9.9%	5.0%	5.7%	3.5%	97.4%

Note 1: Data are based on weight of wet waste of MSW without industrial waste at generation around year 2000.
Note 2: The region-specific values are calculated from national, partly incomplete composition data. The percentages given may therefore not add up to 100%. Some regions may not have data for some waste types - blanks in the table represent missing data.

IPCC 2006 Volume 5 Chapter 3: Solid Waste Disposal. Table 3.3: Recommended Default Methane Generation Rate (k) Values Under Tier 1

Type of Waste		Climate Zone: Boreal and Temperate (MAT ≤20°C) Dry (MAP/PET < 1) Default	Range	Wet (MAP/PET > 1) Default	Range	Tropical (MAT >20°C) Dry (MAP < 1000 mm) Default	Range	Moist and Wet (MAP≥ 1000 Default	Range
Slowly degrading waste	Paper/textiles waste	0.04	0.03 - 0.05	0.06	0.05 - 0.07	0.045	0.04 - 0.06	0.07	0.06 - 0.085
Slowly degrading waste	Wood/straw waste	0.02	0.01 - 0.03	0.03	0.02 - 0.04	0.025	0.02 - 0.04	0.35	0.03 - 0.05
Moderately degrading waste	Other (non-food) organic	0.05	0.04 - 0.06	0.10	0.06 - 0.1	0.065	0.05 - 0.08	0.17	0.15 - 0.2
Rapidly degrading waste	Food waste/Sewage sludge	0.06	0.05 - 0.08	0.19	0.1 - 0.2	0.085	0.07 - 0.1	0.40	0.17 - 0.7
Bulk waste		0.05	0.04 - 0.06	0.09	0.08 - 0.1	0.065	0.05 - 0.08	0.17	0.15 - 0.2

MAT – Mean annual temperature;
MAP – Mean annual precipitation;
PET – Potential evapotranspiration.
The average annual MAT, MAP and PET during the time series selected to estimate the emission and indicated by the nearest representative meteorological station. The information available is not adequate to subdivide temperate into cold (<10°C) and warm (10-20°C). In this IPCC classification for warm temperate, MAT is referred to the growing season.

IPCC Guidelines Volume 5, Chapter 2, Table 2.4: Default dry matter content, DOC content, total carbon content and fossil carbon fraction of different MSW components

MSW component	DM as % of wet weight[1] Default	DOC content in % of wet waste Default	Range[2]	DOC content in % of dry waste Default	Range	Total carbon content in % of dry weight Default	Range	Fossil carbon content in % of total carbon Default	Range
Paper / Cardboard	90%	40%	36%-45%	44%	40%-50%	46%	42%-50%	1%	0%-5%
Textiles	80%	24%	20%-40%	30%	25%-50%	50%	25%-50%	20%	0%-50%
Food waste	40%	15%	18%-32%	38%	20%-50%	38%	20%-50%	0	0
Wood	85%	43%	39%-46%	50%	46%-54%	50%	46%-54%	0	0
Garden and Park waste	40%	20%	18%-22%	49%	45%-55%	49%	45%-55%	0	0
Nappies	40%	24%	18%-32%	60%	44%-80%	70%	54%-90%	10%	10%
Rubber / Leather	84%	39%	39%	47%	47%	67%	67%	20%	20%
Plastics	100%	0	0	0	0	75%	67%-85%	100%	95%-100%
Metal	100%	0	0	0	0	0	0	0	0
Glass	100%	0	0	0	0	0	0	0	0
Other, inert waste	90%	0	0	0	0	3%	0%-5%	100%	50%-100%

1. The moisture content given here applies to the specific waste types before they enter the collection and treatment. In samples taken from collected waste or from e.g., SWDS the moisture content of each waste type will vary by moisture of co-existing waste and weather during handling.
2. The range refers to the minimum and maximum data reported by Dehoust et al., 2002; Gangdonggu, 1997; Guendehou, 2004; JESC, 2001; Jager and Blok, 1993; Würdinger et al., 1997; and Zeschmar-Lahl, 2002.
3. 40 percent of textile are assumed to be synthetic (default). Expert judgement by the authors.
4. The value for wood is for wood products at the end of life. Typical dry matter content of wood at the time of harvest (that is for garden and park waste) is 40 percent. Expert judgement by the authors.
5. Natural rubbers would likely not degrade under anaerobic condition at SWDS (Tsuchii et al., 1985; Rose and Steinbüchel, 2005).
6. Metal and glass contain some carbon of fossil origin. Combustion of significant amounts of glass or metal is not common.

IPCC Guidelines Volume 5, Chapter 2, Table 2.5: Default DOC and fossil carbon content in industrial waste*

Industry type	DOC	Fossil carbon	Total carbon	H2O content[2]
Food, beverages and tobacco (other than sludge)	15	-	15	60
Textile	24	16	40	20
Wood and wood products	43	-	43	15
Pulp and paper (other than sludge)	40	1	41	10
Petroleum products, Solvents, Plastics	-	80	80	0
Rubber	39	17	56	16
Construction and demolition	4	20	24	0
Other[4]	1	3	4	10

1. The default values apply only for process waste from the industries, office and other similar waste are assumed to be included in MSW.
2. Note that water contents of industrial wastes vary enormously, even within a single industry.
3. Natural rubbers would likely not degrade under anaerobic condition at SWDS (Tsuchii, et al., 1985; Rose and Steinbüchel, 2005).
4. These values can be used also as defaults for total waste from manufacturing industries, when data on waste production by industry type are not available. Waste from mining and quarrying should be excluded from the calculations as the amounts can be large and the DOC and fossil carbon contents are likely to be negligible.

BIOLOGICAL TREATMENT OF SOLID WASTE EMISSIONS CALCULATOR (III.2)

This tool has been designed to help cities estimate methane (CH_4) and nitrous oxide (N_2O) emissions from biological treatment of waste (composting or anaerobic digestion)
All default values and their sources can be found in the Data Table section below.

1. Instructions

1.	Grey cells contain formulas and default values based on IPCC 2006 Guidelines for National Greenhouse Gas Inventories. Please do not modify these.
2.	White cells, in the calculation table, are for user-entered data ('override'). Where applicable, these can be used to override the default data in the grey cells.
3.	All red cells must be completed; enter total amount of organic waste treated biologically in metric tonnes and select "Type of waste" in the City information box
4.	Select "Treatment type" and enter amount of organic waste treated as either kg or % in the Calculation table

2. City information

City information	Default	
City	Houston	
Country	USA	
Total organic waste treated biologically in metric tonnes	236,266	< Enter amount
Type of waste	Wet waste	< Select from list
Global Warming Potential	4AR	

>>> Wet waste is not treated before measuring, while dry waste is estimated after drying

3. Emissions summary

Source	Total GHGs (metric tonnes CO_2e)		
	CH_4	N_2O	Total
Composting	23,627	16,898	40,524
Anaerobic digestion	0	Not occurring	
Total	23,627	16,898	40,524

4. Calculations for methane (CH_4) and nitrous oxide (N_2O) emissions from biological treatment of waste

Formulas

GPC equation 8.5

CH_4 emissions $= \Sigma i\ (\ Mi * EFi\ ) * 0{,}001 - Ri$

M_i	= Mass of organic waste treated by biological treatment type i, Gg
EF_i	= Emission factor for treatment i, gCH4/kg waste treated
i	= Composting or anaerobic digestion
R_i	= Total amount of CH4 recovered, t CH4; default 0

N_2O emissions $= \Sigma i\ (\ Mi * EFi\ ) * 0{,}001$

M_i	= Mass of organic waste treated by biological treatment type i, Gg
EF_i	= Emission factor for treatment i, gN2O/kg waste treated
i	= Composting or anaerobic digestion

Calculation table

Treatment type	Organic waste treated		Emission factor[1]				Amount of CH_4 recovered, tCH_4		Total GHG emissions				
	Mass, tonnes	or % of total waste	CH_4, gCH_4/kg waste treated		N_2O, gN_2O/kg waste treated				CH_4		N_2O		Total
			Default	Override	Default	Override	Default	Override	tCH_4	tCO_2e	tN_2O	tCO_2e	tCO_2e
Composting	236,266		4.0		0.24		0		945	23627	57	16898	40524
Please select							0						
Please select							0						
Please select							0						
Please select							0						
			Must add to 100%					Total	945	23627	57	16898	40524

[1] 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 5 Chapter 4 Biological Treatment of Solid Waste Table 4.1: Default emission factors for CH4 and N2O emissions from biological treatment of waste

DATA TABLE

2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 5 Chapter 4 Biological Treatment of Solid Waste Table 4.1: Default emission factors for CH_4 and N_2O emissions from biological treatment of waste

Treatment type	CH_4 (gCH_4/kgWaste)				N_2O (gN_2O/kgWaste)			
	Dry waste		Wet waste		Dry waste		Wet waste	
	Value	Range	Value	Range	Value	Range	Value	Range
Composting	10	0.08-20	4	0.03-8	0.6	0.2-1.6	0.24	0.06-0.6
Anaerobic digestion	2	0-20	0.8	0-8				

Introduction	Set-up	Inventory	Calculators	Results	Notes
Fugitive emissions	Solid waste disposal	Biological treatment	Incineration	Wastewater	

CIRIS

INCINERATION EMISSIONS CALCULATOR (III.3)

This tool has been designed to help cities estimate non-biogenic carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) emissions from the incineration and open burning of solid waste.
All default values and their sources can be found in the Data Table section below.

1. Instructions

1.	Grey cells contain formulas and default values based on IPCC 2006 Guidelines for National Greenhouse Gas Inventories. Please do not modify these.
2.	White cells, in the calculation tables, are for user-entered data ('override'). Where applicable, these can be used to override the default data in the grey cells.
3.	If no city-specific or national data are available, use the default values provided. If city specific or national data are available, please insert information into the appropriate white cells.
4.	All red cells must be completed to estimate GHG emissions; enter the mass of waste in the *City information*, and enter additional information to estimate CH4 and N2O emissions

2. City information

City information	Default	
City	Houston	
Country	USA	
Region	America	< Select from list
Sub-region	North America	< Select from list
Management		< Select from list
		< Enter amount
Global Warming Potential	4AR	

3. EMISSIONS SUMMARY

Source	Total GHGs (metric tonnes CO_2e)			
	CO_2	CH_4	N_2O	Total
0	0	0	0	

4. Non-biogenic CO_2 emissions from the incineration of waste

Formula

GPC equation 8.6, Non-biogenic CO_2 emissions from the incineration of waste

CO_2 emissions	= m * Σi (WFi * dmi * Cfi * FCFi * OFi) * (44/12)
m	= Mass of waste incinerated, in tonnes
WFi	= Fraction of waste containing type i matter
dm_i	= Dry matter content in the type i matter
CF_i	= Fraction of carbon in the dry matter of type i matter
FCF_i	= Fraction of fossil carbon in the total carbon component of type i matter
OF_i	= Oxidation fraction or factor
44/12	= Molecular weight ratio of CO2 and carbon
i	= Matter type of the Solid Waste incinerated, such as paper/cardboard, textile, food waste, etc.

Calculation table

Waste incinerated, tonnes	Waste type	MSW type of waste incinerated (type i matter)	% waste containing type i matter (WF_i)		Dry matter content in the type i matter (dm_i)		Fraction of carbon in the dry matter of type i matter (CF_i)		Fraction of fossil carbon in the total carbon component of type i matter (FCF_i)		Oxidation fraction or factor (OF_i)		Molecular weight ratio of CO_2 and carbon	Total CO_2 emissions
Value			Default	Override	Default	Override	Default	Override	Default	Override	Default	Override	Default	Value
	MSW	Food waste	33.9%		40%		38%		0%				3.67	
		Paper / Cardboar	23.2%		90%		46%		1%				3.67	
		Wood	6.2%		85%		50%		0%				3.67	
		Textiles	3.9%		80%		50%		20%				3.67	
		Garden and Park	No default >		40%		49%		0%				3.67	
		Nappies	No default >		40%		70%		10%				3.67	
		Rubber / Leather	1.4%		84%		67%		20%				3.67	
		Plastics	8.5%		100%		75%		100%				3.67	
		Metal	4.6%		100%		0%		0%				3.67	
		Glass	6.5%		100%		0%		0%				3.67	
		Other, inert wast	9.8%		90%		3%		100%				3.67	
	Industrial waste				No default >		No default >		No default >				3.67	
	Clinical waste				No default >		No default >		No default >				3.67	
	Sewage sludge				No default >		No default >		No default >				3.67	
	Fossil liquid waste				No default >		No default >		No default >				3.67	
		Total	98%	0%	Must add to 100%								Total	0

5. Methane (CH_4) emissions from the incineration of solid waste

Formula

GPC Equation 8.7. CH_4 emissions from the incineration of waste

CH_4 emissions	$\Sigma(IW_i * EF_i) * 10^{-6}$
IW_i	= Amount of solid waste type i incinerated or open burned, tonnes
EF_i	= Aggregate CH4 emission factor, g CH4/tonne waste type i
10^{-6}	= Converting factor from gCH4 to t CH4
i	= Category or type of waste incinerated, specified as follows: municipal solid waste, industrial waste, sludge (except sewage sludge), sewage

Calculation table (MSW only)

Waste incinerated, tonnes	Type of waste	Type of incineration	Technology	CH_4 emission factor, gCH_4/tonne waste type i		Converting factor from gCH_4 to tCH_4	Total CH_4 emissions	
							tCH_4	tCO_2e
Value		Select	Select	Default	Override	Default	Value	
	MSW	Continuous incine	Stoker	0.2		0.000001		
	MSW	Continuous incine	Fluidised bed	0.0		0.000001		
	MSW	Semi-continuous	Stoker	6.0		0.000001		
	MSW	Semi-continuous	Fluidised bed	188.0		0.000001		
	MSW	Batch type inciner	Stoker	60.0		0.000001		
	MSW	Batch type inciner	Fluidised bed	237.0		0.000001		
						Total	0	0

6. Nitrous oxide (N_2O) emissions from the incineration of solid waste

Formula

GPC Equation 8.8. N_2O emissions from the incineration of waste

N_2O emissions	=Σ(IWi * EFi) * 10-6
IW_i	= Amount of solid waste type i incinerated or open burned, tonnes
EF_i	= Aggregate N2O emission factor, g N2O/tonne waste type i
10^{-6}	= Converting factor from gN2O to tN2O
i	= Category or type of waste incinerated, specified as follows: municipal solid waste, industrial waste, sludge (except sewage sludge), sewage

Calculation table

Waste incinerated, tonnes	Type of waste	Type of technology/management practice	Weight basis	N_2O emission factor, g N_2O/tonne waste type i		Converting factor from gN_2O to tN_2O	Total N_2O emissions	
							tNO_2	tCO_2e
Value				Default	Override	Default		
	MSW	Continuous and semi-	Wet weight	50		0.000001		
	MSW	Batch type incinerators	Wet weight	60		0.000001		
	MSW	Open burning	Dry weight	150		0.000001		
	Industrial waste	All types of incineration	Wet weight	100		0.000001		
	Sludge (except sewage sludge)	All types of incineration	Wet weight	450		0.000001		
	Sewage sludge	Incineration	Dry weight	990		0.000001		
	Sewage sludge	Incineration	Wet weight	900		0.000001		
						Total	0	0

DATA TABLE

IPCC 2006 Volume 5 Chapter 2: Waste Generation, Composition and Management Data. Table 2.3: MSW composition data by percent - regional defaults

Region	Sub-region	Food waste	Paper / cardboard	Wood	Textiles	Rubber / leather	Plastic	Metal	Glass	Other	Total
Asia	Eastern Asia	26.2%	18.8%	3.5%	3.5%	1.0%	14.3%	2.7%	3.1%	7.4%	80.5%
	outh-Central A	40.3%	11.3%	7.9%	2.5%	0.8%	6.4%	3.8%	3.5%	21.9%	98.4%
	outh-Eastern A	2.5%	12.9%	9.9%	2.7%	0.9%	7.2%	3.3%	4.0%	16.3%	60.7%
	rn Asia & Midd	41.1%	18.0%	9.8%	2.9%	0.6%	6.3%	1.3%	2.2%	5.4%	87.6%
Africa	Eastern Africa	53.9%	7.7%	7.0%	1.7%	1.1%	5.5%	1.8%	2.3%	11.6%	92.6%
	Middle Africa	43.4%	16.8%	6.5%	2.5%		4.5%	3.5%	2.0%	1.5%	80.7%
	Northern Afric	51.1%	16.5%	2.0%	2.5%		4.5%	3.5%	2.0%	1.5%	83.6%
	Southern Afric	23.0%	25.0%	15.0%							63.0%
	Western Afric	40.4%	9.8%	4.4%	1.0%		3.0%	1.0%			59.6%
Europe	Eastern Europ	30.1%	21.8%	7.5%	4.7%	1.4%	6.2%	3.6%	10.0%	14.6%	99.9%
	Northern Europ	23.8%	30.6%	10.0%	2.0%		13.0%	7.0%	8.0%		94.4%
	Southern Europ	36.9%	17.0%	10.6%							64.5%
	Western Europ	24.2%	27.5%	11.0%							62.7%
Oceania	alia and New Z	36.0%	30.0%	24.0%							90.0%
	Rest of Oceani	67.5%	6.0%	2.5%							76.0%
America	North Americ	33.9%	23.2%	6.2%	3.9%	1.4%	8.5%	4.6%	6.5%	9.8%	98.0%
	Central Americ	43.8%	13.7%	13.5%	2.6%	1.0%	6.7%	2.6%	3.7%	12.3%	99.9%
	South Americ	44.9%	17.1%	4.7%	2.6%	0.7%	10.8%	2.9%	3.3%	13.0%	100.0%
	Caribbean	46.9%	17.0%	2.4%	5.1%	1.9%	9.9%	5.0%	5.7%	3.5%	97.4%

Note 1: Data are based on weight of wet waste of MSW without industrial waste at generation around year 2000.
Note 2: The region-specific values are calculated from national, partly incomplete composition data. The percentages given may therefore not add up to 100%. Some regions may not have data for some waste types - blanks in the table represent missing d

GPC Table 8.4. Default data for CO_2 emission factors for incineration and open burning

Parameter	Management practice	MSW	Industrial waste	Clinical waste	Sewage sludge	Fossil liquid waste
Dry matter content in % of wet waste		(see Note 1)	NA	NA	NA	NA
Total carbon content in % of dry weight		(see Note 1)	50%	60%	45%	80%
Fossil carbon fraction in % of total carbon content		(see Note 2)	90%	40%	0%	100%
Oxidation factor in % of carbon input	Incineration	100%	100%	100%	100%	100%
	Open burning	58%	NO	NO	NO	NO

Note 1: Default data available in 2006 IPCC Guidelines, Vol. 5, Ch. 2, Table 2.4 in Section 2.3 Waste composition and equation 5.8 (for dry matter), Equation 5.9 (for carbon content) and Equation 5.10 (for fossil carbon fraction) in 2006 IPCC Guidelines, Vol. 5, C
Note 2: Default data by industry type is given in 2006 IPCC Guidelines, Vol. 5, Ch. 2 Table 2.5 in Section 2.3 Waste composition. For estimation of emissions, use equations mentioned in Note 1.
Note 3: When waste is open-burned, refuse weight is reduced by approximately 49 to 67 percent (US-EPA, 1997, p.79). A default value of 58 percent is suggested.
Note 4: Sewage slude: See Section 2.3.2 Sludge in Chapter 2.
Note 5: Fossil liquid waste is here defined as industrial and municipal residues, based on mineral oil, natural gas or other fossil fuels. It includes waste formerly used as solvents and lubricants. It does not include wastewater, unless it is incinerated (e.g., because of a high solvent content) The total carbon content of fossil liquid waste is provided in percent of wet weight and not in percent of dry weight (GIO, 2005).
References: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, chapter 5: Incineration and Open Burning of Waste

GPC Table 8.5. CH_4 emission factors for incineration of MSW

Type of incineration/technology			CH_4 emission factors (kg/Gg waste incinerated on a wet
MSW	Continuous incin	S	0.2
		F	0
	Semi-continuous	S	6
		F	188
	Batch type incine	S	60
		F	237

Note: In the study cited for this emission factor, the measured CH_4 concentration in the exhaust air was lower than the concentration in ambient air.
Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, chapter 5: Incineration and Open Burning of Waste, Table 5.3

GPC Table 8.6. Default N_2O emission factors for different types of waste and management practices

Type of waste, technology/management practice, weight basis			Emission factor (g N_2O/t waste incinerated)
MSW	Continuous and s	W	50
MSW	Batch type incine	W	60
MSW	Open burning	D	150
Industrial waste	All types of incin	W	100
S	All types of incin	W	450
Sewage sludge	Incineration	D	990
Sewage sludge	Incineration	W	900

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, chapter 5: Incineration and Open Burning of Waste, Table 5.6

IPCC Guidelines Volume 5, Chapter 2, Table 2.4: Default dry matter content, DOC content, total carbon content and fossil carbon fraction of different MSW components

MSW component	DM as % of wet weight[1]	DOC content in % of wet waste		DOC content in % of dry waste		Total carbon content in % of dry weight		Fossil carbon content in % of total carbon	
	Default	Default	Range[2]	Default	Range	Default	Range	Default	Range
Paper / cardboard	90%	40%	36%-45%	44%	40%-50%	46%	42%-50%	1%	0%-5%
Textiles	80%	24%	20%-40%	30%	25%-50%	50%	25%-50%	20%	0%-50%
Food waste	40%	15%	18%-32%	38%	20%-50%	38%	20%-50%	0	0
Wood	85%	43%	39%-46%	50%	46%-54%	50%	46%-54%	0	0
Garden and Park waste	40%	20%	18%-22%	49%	45%-55%	49%	45%-55%	0	0
Nappies	40%	24%	18%-32%	60%	44%-80%	70%	54%-90%	10%	10%
Rubber / Leather	84%	39%	39%	47%	47%	67%	67%	20%	20%
Plastics	100%	0	0	0	0	75%	67%-85%	100%	95%-100%
Metal	100%	0	0	0	0	0	0	0	0
Glass	100%	0	0	0	0	0	0	0	0
Other, inert waste	90%	0	0	0	0	3%	0%-5%	100%	50%-100%

1. The moisture content given here applies to the specific waste types before they enter the collection and treatment. In samples taken from collected waste or from e.g., SWDS the moisture content of each waste type will vary by moisture of co-existing waste and weather during handling.
2. The range refers to the minimum and maximum data reported by Dehoust et al., 2002; Gangdonggu, 1997; Guendehou, 2004; JESC, 2001; Jager and Blok, 1993; Würdinger et al., 1997; and Zeschmar-Lahl, 2002.
3. 40 percent of textile are assumed to be synthetic (default). Expert judgement by the authors.
4. The value for wood is for wood products at the end of life. Typical dry matter content of wood at the time of harvest (that is for garden and park waste) is 40 percent. Expert judgement by the authors.
5. Natural rubbers would likely not degrade under anaerobic condition at SWDS (Tsuchii et al., 1985; Rose and Steinbüchel, 2005).
6. Metal and glass contain some carbon of fossil origin. Combustion of significant amounts of glass or metal is not common.

IPCC Guidelines Volume 5, Chapter 2, Table 2.5: Default DOC and fossil carbon content in industrial waste[1]

Industry type	DOC	Fossil carbon	Total carbon	H2O content[2]
Food, beverages and tobacco (other than sludge)	15	-	15	60
Textile	24	16	40	20
Wood and wood products	43	-	43	15
Pulp and paper (other than sludge)	40	1	41	10
Petroleum products, Solvents, Plastics	-	80	80	0
Rubber[3]	39	17	56	16
Construction and demolition	4	20	24	0
Other[4]	1	3	4	10

1. The default values apply only for process waste from the industries, office and other similar waste are assumed to be included in MSW.
2. Note that water contents of industrial wastes vary enormously, even within a single industry.
3. Natural rubbers would likely not degrade under anaerobic condition at SWDS (Tsuchii, et al., 1985; Rose and Steinbüchel, 2005).
4. These values can be used also as defaults for total waste from manufacturing industries, when data on waste production by industry type are not available. Waste from mining and quarrying should be excluded from the calculations as the amounts can be large and the DOC and fossil carbon contents are likely to be negligible.

Introduction | Set-up | Inventory | Calculators | Results | Notes
Fugitive emissions | Solid waste disposal | Biological treatment | Incineration | Wastewater

WASTEWATER EMISSIONS CALCULATOR (III.4)

This tool has been designed to help cities estimate methane (CH_4) and nitrous oxide (N_2O) emissions from treatment of domestic, commercial and industrial wastewater.
All default values and their sources can be found in the Data Table section below.

1. Instructions

1.	The wastewater emissions calculator separately calculates emissions from domestic and commercial wastewater, and industrial wastewater.
2.	Grey cells contain formulas and default values based on IPCC 2006 Guidelines for National Greenhouse Gas Inventories. Please do not modify these.
3.	White cells, in the calculation tables, are for user-entered data ('override'). Where applicable, these can be used to override the default data in the grey cells.
4.	Red cells in the City information section must be completed for the tool to estimate default emissions from domestic-commercial wastewater.
5.	To estimate GHG emissions from treatment of industrial wastewater, the industry type, total industry product, and % wastewater treated by method in Section 5 must be specified.

2. City information

City information		Default	Override
City		Houston	
Country		USA	
Proxy region/country for wastewater BOD value		UnitedStates	< Select from list
Proxy country for wastewater treatment type		United States	< Select from list
Proxy country for protein consumption		United States of America	< Select from list
Garbage disposal		Garbage disposals	< Select from list
Population		2,239,558	
Global Warming Potential		4AR	
Fraction of population in income group (U)	% urban high i	78%	
	% urban low i	0%	
	% rural	22%	
	Check	100%	< Use default values
Climate (wet/dry)		Wet	< Select from list

>>> A garbage disposal unit is a device installed under a kitchen sink between the sink's drain and the trap that shreds food waste into pieces small enough to pass through plumbing

3. Emissions summary

Source	Total GHGs (metric tonnes CO_2e) CH_4	N_2O	Total
Domestic / Commercial	158,394	58,950	217,344
Industrial	0		0
Total	158,394	58,950	217,344

4. Domestic and commercial wastewater

4a. Methane (CH4) emissions from domestic-commercial wastewater

Formulas

CH4 emissions	= Σi [(TOWi - Si) * EFi - Ri] * 0.001
TOWi	= Organic content of wastewater, kgBOD for domestic wastewater, kgCOD for industrial wastewater
Si	= Organic component removed as sludge, kgBOD/yr or kgCOD/yr; default 0
EF	= Emission factor, kgCH4 per kg BOD or kgCH4 per kg COD
R	= Amount of CH4 recovered, kgCH4/yr; default 0

TOW	= [P * BOD * I * 365] * 0.001
P	= Population
BOD	= City-specific per capita biochemical oxygen demand, g/person/day
I	= Correction factor for additional industrial BOD discharged into sewers; 1.25 for collected wastewater, 1.00 for uncollected
365	= Number of days per year

EF	= B * MCF * U * T
B	= Maximum CH4 producing capacity, default 0.6kgCH4/kgBOD
MCF	= Methane correction factor (fraction)
U	= Fraction of population in income group i
T	= Degree of utilisation of treatment/discharge pathway or system for each income group fraction i

Calculation table

Treatment	General treatment: Type of treatment	% water treated (U*T)[1] Urban: high	Urban: low	Rural	Specific treatment (optional): Type of treatment	Comment	% water treated Override	Population (P) Value	BOD g/person/day Default	Override	Correction factor for industrial discharge, I Default	Override	Days per year Value	Total Value	Organic component removed as sludge (S) Default	Override	Maximum CH_4 producing capacity Default	Override	MCF General[2] Urban: high	Urban: low	Rural	MCF Specific Default	Override	EF Total Value	Amount of CH_4 recovered, $kgCH_4/yr$ Default	Override	Total CH_4 emissions tCH_4	tCO_2e
Non-treated	None	0%	0.0%	0%	Sea, river and lake	Rivers with high organics loadings can turn anaerobic		2239558	85		1.25		365	86852859	0		0.6		0	0.5	0.5	0.1		0	0		0	0
	Sewer	74.1%	0.0%	2%	Stagnant sewer	Open and warm		2239558	85		1.25		365	86852859	0		0.6		0	0.5	0	0.5		0	0		0	0
					Flowing sewer	Fast moving, clean (CH_4 from pump stations insignificant)		2239558	85		1.25		365	86852859	0		0.6					0.0		0	0		0	0
Treated	Septic System	3.9%	0.0%	20%	Septic System	Half of BOD settles in anaerobic tank		2239558	85		1.25		365	86852859	0		0.6		0.5	0.5	0.5	0.5		0.0711	0		6175	154381
	Latrine	0.0%	0.0%	0%	Latrine	Dry climate, ground water table < latrine, 3-5 persons		2239558	85		1.25		365	86852859	0		0.6		0.7	0.7	0.7	0.1		0.001848	0		161	4013
					Latrine	Dry climate, ground water table < latrine, many users		2239558	85		1.25		365	86852859	0		0.6					0.5		0	0		0	0
					Latrine	Wet climate/flush water use, ground water table > latrine		2239558	85		1.25		365	86852859	0		0.6					0.7		0	0		0	0
					Latrine	Regular sediment removal for fertilizer		2239558	85		1.25		365	86852859	0		0.6					0.1		0	0		0	0
	Other	0%	0.0%	0%	Aerobic treatment plant	Must be well managed		2239558	85		1.25		365	86852859	0		0.6		0.1	0.5	0.1	0.0		0	0		0	0
					Aerobic treatment plant	Not well managed. Overloaded		2239558	85		1.25		365	86852859	0		0.6					0.3		0	0		0	0
					Anaerobic digester:	CH_4 recovery is not considered here		2239558	85		1.25		365	86852859	0		0.6					0.8		0	0		0	0
					Anaerobic reactor	CH_4 recovery is not considered here		2239558	85		1.25		365	86852859	0		0.6					0.8		0	0		0	0
					Anaerobic shallow lagoon	Depth less than 2 metres		2239558	85		1.25		365	86852859	0		0.6					0.2		0	0		0	0
					Anaerobic deep lagoon	Depth more than 2 metres		2239558	85		1.25		365	86852859	0		0.6					0.8		0	0		0	0
							0%	Must add to 100%																		Total	6336	158394

4b. Nitrous Oxide (N2O) emissions from domestic-commercial wastewater

Formulas

N_2O emissions	= N2OEFFLUENT + N2OPLANTS
$N_2O_{EFFLUENT}$	= N2O emissions from wastewater effluent
N_2O_{PLANTS}	= N2O emissions from centralised wastewater treatment processes

N_2O_{PLANTS}	= P * TPLANT * FIND-COM * EFPLANT
P	= Population
T_{PLANT}	= Degree of utilisation of modern, centralised WWT plants; default 0%
$F_{IND-COM}$	= Fraction for industrial and commercial co-discharged protein; default 1.25
EF_{PLANT}	= Emission factor; 0.0032 kgN2O/person/yr

$N_2O_{EFFLUENT}$	= [(P * Protein * FNPR * FNON-CON * FIND-COM) - NSLUDGE - NWWT] * EFEFFLUENT * 44/28
P	= Population
Protein	= Annual per capita protein consumption, kg/person/yr
F_{NPR}	= Fraction of nitrogen in protein; 0.16 kgN per kg protein
$F_{NON-CON}$	= Fraction for non-consumed protein added to wastewater; default 1.1 without garbage disposals, 1.4 with
$F_{IND-COM}$	= Fraction for industrial and commercial co-discharged protein into sewer system; default 1.25
N_{SLUDGE}	= Nitrogen removed with sludge, kgN/yr; default 0
N_{WWT}	= N2OPLANTS * 28/44, kgN/yr; default 0
$EF_{EFFLUENT}$	= Emission factor for N2O emissions from discharge to wastewater, kgN2O-N/kgN2O; default 0.005kgN2O-N/kgN
44/28	= Conversion of kgN2O-N into kgN2O

Calculation table

Population Value	Degree of advanced WWT plants Override	Annual per capita protein consumption, kg/person/yr Default	Override	Fraction of nitrogen in protein, F_{NPR} Default	Fraction to adjust for non-consumed protein, $F_{NON-CON}$ Default	Override	Fraction of industrial / commercial co-discharged protein, $F_{IND-COM}$ Default	Override	Nitrogen removed with sludge, kg N (N_{sludge}) Default	Override	Emission factor, kgN_2O-N/kgN_2O ($EF_{EFFLUENT}$) Default	Override	Total N_2O, kgN_2O Effluent	Advanced WWT plants	Total N_2O emissions tN_2O	tCO_2e
2239558	0%	40.15		0.16	1.4		1.25		0		0.005		197820	0	198	58950

5. INDUSTRIAL WASTEWATER

5a. Methane (CH4) emissions from industrial wastewater

Formulas

CH_4 emissions	= Σi [(TOWi - Si) * EFi - Ri] * 0.001
TOWi	= Organic content of wastewater, kgCOD
Si	= Organic component removed as sludge, kgCOD/yr; default 0
EF	= Emission factor, kgCH4 per kg COD
R	= Amount of CH4 recovered, kgCH4/yr; default 0

TOW	= [P * W * COD]
P	= Total industrial product for each industrial category, tonnes
W	= Wastewater generated by each indusytrial sector, m3/tonne
COD	= Chemical oxygen demand for each industrial sector, kg/m3

EF	= B * MCF * T
B	= Maximum CH4 producing capacity; default 0.6kgCH4/kgBOD
MCF	= Methane correction factor (fraction)
T	= Degree of utilisation of treatment method

Calculation table

Industry Type (select)	Total product (tonnes) Value	Wastewater generation (m3/tonne) Default	Override	Chemical oxygen demand (COD; kg/m3) Default	Override	Total organically degradable carbon in wastewater (TOW; kgCOD/year) Default	Override	Organic component removed as sludge (kg COD/yr) Default	Override	Amount of CH_4 recovered (kg CH_4/yr) Default	Override	Aerobic treatment plant - well managed	Aerobic treatment plant - not well managed	Anaerobic digester for sludge	Anaerobic digester (e.g. UASB, fixed film reactor)	Anaerobic shallow lagoon < 2 metres	Anaerobic deep lagoon > 2 metres	Sea, river and lake discharge	Must add up to 100%	Maximum CH4 producing capacity (B_o, kg CH_4/kg COD) Default	Override	MCF[2] Aerobic treatment plant - well managed Default	Override	Aerobic treatment plant - not well managed Default	Override	Anaerobic digester for sludge[3] Default	Override	Anaerobic digester (e.g. UASB, fixed film reactor)[3] Default	Override	Anaerobic shallow lagoon < 2 metres Default	Override	Anaerobic deep lagoon > 2 metres Default	Override	Sea, river and lake discharge Default	Override	CH_4 emission factor ($kgCH_4$/kg COD) Value	Total CH_4 emissions tCH_4	tCO_2e
Soap and detergents	1000000									0		20%	20%	20%	20%				80%	0.25		0		0.3		0.8		0.8		0		0		0		0.10	0	0
																						0		0		0		0		0		0		0				
																						0		0		0		0		0		0		0				
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																						0		0		0		0		0		0		0				
																						0		0		0		0		0		0		0				
																						0		0		0		0		0		0		0				
																																				Total	0	0

DATA TABLES

IPCC 2006 Volume 5 Chapter 6: Wastewater, Table 6.5: Suggested Values for Degree of Treatment, Discharge Pathway or Method for Each Income Group for Selected Countries

Region	Country	[illegible]			Degree of utilisation of treatment or discharge (T)														
Africa	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0%	[illegible]	0%	17%	24%	5%	34%	20%	2%	28%	4%	10%	56%

[illegible]

IPCC 2006 Volume 5 Chapter 6: Wastewater, Table 6.4 Estimated BOD values in domestic wastewater for selected regions and countries

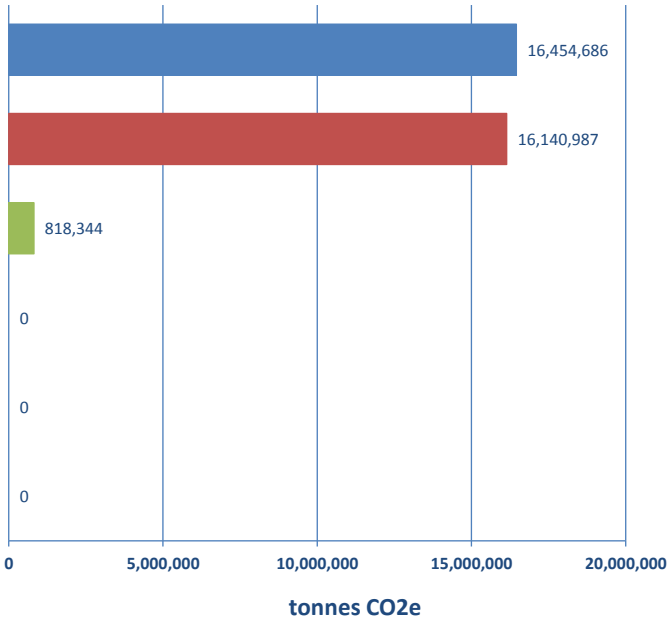
Treatment	BOD (g/person/day)	
Africa	[illegible]	[illegible]
Egypt	[illegible]	[illegible]

[illegible]

SUMMARY

NAME OF CITY:	Houston, USA	**POPULATION:**	2,239,558
BOUNDARY:	BASIC	**LAND AREA (km2):**	1,553
INVENTORY YEAR:	2014	**GDP (US$ million):**	522,028

tCO2e	BASIC	Scope 1	Scope 2	Scope 3
	Stationary	2,876,173	13,578,513	
	Transportation	16,140,987		
	Waste	246,760		571,584
	IPPU			
	AFOLU			
	Other Scope 3			
	TOTAL	33,414,017		



Intensity indicators	Per capita	Per unit land area (km2)	Per unit GDP (US$m)
Emissions	14.9	21,517	64

OVERVIEW (GPC CHAPTER 4.4, TABLE 4.2, PAGE 41)

NAME OF CITY: Houston, USA
LEVEL: BASIC
INVENTORY YEAR: 2014

POPULATION: 2,239,558
LAND AREA (km2): 1,553
GDP (US$ million): 522,028

GHG Emissions Source (By Sector)		Total GHGs (metric tonnes CO2e)					
		Scope 1	Scope 2	Scope 3	BASIC	BASIC+	BASIC+ S3
STATIONARY ENERGY	Energy use (all emissions except I.4.4)	2,876,173	13,578,513		16,454,686	16,454,686	16,454,686
	Energy generation supplied to the grid (I.4.4)	419,308					
TRANSPORTATION	(all II emissions)	16,140,987			16,140,987	16,140,987	16,140,987
WASTE	Waste generated in the city (III.X.1 and III.X.2)	246,760		571,584	818,344	818,344	818,344
	Waste generated outside city (III.X.3)	482,861					
IPPU	(all IV emissions)						
AFOLU	(all V emissions)						
OTHER SCOPE 3	(all VI emissions)						
TOTAL		**20,166,089**	13,578,513	571,584	**33,414,017**	**33,414,017**	**33,414,017**

GPC ref No.	GHG Emissions Source (By Sector and Sub-sector)	Total GHGs (metric tonnes CO_2e)			
		Scope 1	Scope 2	Scope 3	Total
I	STATIONARY ENERGY				
I.1	Residential buildings	1,120,913	4,301,936	NE	5,422,849
I.2	Commercial and institutional buildings and facilities	548,931	9,276,576	NE	9,825,507
I.3	Manufacturing industries and construction	1,165,759	IE	NE	1,165,759
I.4.1/2/3	Energy industries	IE	IE	NE	
I.4.4	Energy generation supplied to the grid	419,308			
I.5	Agriculture, forestry and fishing activities	IE	IE	NE	
I.6	Non-specified sources	NO	NO	NE	
I.7	Fugitive emissions from mining, processing, storage, and transportation of coal	NO			
I.8	Fugitive emissions from oil and natural gas systems	40,570			40,570
SUB-TOTAL	(city induced framework only)	**2,876,173**	**13,578,513**		**16,454,686**
II	TRANSPORTATION				
II.1	On-road transportation	15,932,882	IE	NE	15,932,882
II.2	Railways	207,451	IE	NE	207,451
II.3	Waterborne navigation	NO	NO	NE	
II.4	Aviation	654	NO	NE	654
II.5	Off-road transportation	NO	NO	NE	
SUB-TOTAL	(city induced framework only)	**16,140,987**			**16,140,987**
III	WASTE				
III.1.1/2	Solid waste generated in the city	29,416		531,060	560,475
III.2.1/2	Biological waste generated in the city	NO		40,524	40,524
III.3.1/2	Incinerated and burned waste generated in the city	NO		NO	
III.4.1/2	Wastewater generated in the city	217,344		NO	217,344
III.1.3	Solid waste generated outside the city	482,861			
III.2.3	Biological waste generated outside the city	NO			
III.3.3	Incinerated and burned waste generated outside city	NO			
III.4.3	Wastewater generated outside the city	NO			
SUB-TOTAL	(city induced framework only)	**246,760**		**571,584**	**818,344**
IV	INDUSTRIAL PROCESSES and PRODUCT USES				
IV.1	Emissions from industrial processes occurring in the city boundary	NE			
IV.2	Emissions from product use occurring within the city boundary	NE			
SUB-TOTAL	(city induced framework only)				
V	AGRICULTURE, FORESTRY and OTHER LAND USE				
V.1	Emissions from livestock	NE			
V.2	Emissions from land	NE			
V.3	Emissions from aggregate sources and non-CO2 emission sources on land	NE			
SUB-TOTAL	(city induced framework only)				
VI	OTHER SCOPE 3				
VI.1	Other Scope 3			NE	
TOTAL	(city induced framework only)	**19,263,921**	**13,578,513**	**571,584**	**33,414,017**

NET EMISSIONS (GPC CHAPTER 4.3, PAGE 40)

If your city has a net emissions GHG reduction target, please use the tables below to record your emission credits and allocate these to a sector. The "Add" function allows you to select the required number of rows for each tyoe of emission credit. The summary table will then show your city's net emissions according to the GPC framework. For more information, please refer to Chapter 4.3 in the GPC.

Scope 2 emissions based on market-based method

This reflects any electricity (or other gird-connected energy) products or programmess that city consumers (individuals, businesses and local government) participate in, generally provided by the electricity supplier(s) serving the city. See GPC Chapter 6.5.1 (Page 67) for a description on how to report this.

	Contractual instrument or program type	Quantity of energy		Emission factor		tCO_2e	Allocate to sector
		Amount	Units	Amount	Units		
Add							
	TOTAL market-based scope 2 emissions (in tCO2e)						

Offset credit transactions

If offset credits are generated in the geographic boundary and sold, these should be documented in the first table and will be *added* to the reported inventory results. Any offsets purchased from outside the geographic boundary (e.g. to meet a city reduction target) should be reported in the second table and will be *deducted* from the reported inventory results.

Offset credits generated within the geographic boundary and sold

	Name of programme / description	Date of sale	tCO_2e	Allocate to sector
Add				
	TOTAL inboundary offset credit transactions (in tCO2e)			

Offset credits purchased from outside the geographic boundary

	Name of programme / description	Date of retirement	tCO_2e	Allocate to sector
Add				
	TOTAL out of boundary offset credit transactions (in tCO2e)			

Renewable energy production or investments

This table records renewable energy generation (in MWh or kWh) produced within the geographic boundary, or reflecting an investment by the city outside the city boundary (e.g. offshore wind) that otherwise only indirectly impacts scope 2 emissions (through a lower grid average emission factor) and that would not be visible in scope 1 emissions for energy generation (due to their zero emissions).

	Technology type	Energy supplied to grid		Located in city boundary?	% outside boundary	Benchmark energy source	Emission factor		Correction (tCO_2e)	tCO_2e	Allocate to sector
		Amount	Units				Amount	Units			
Add											
	TOTAL renewable energy production or investments (in tCO2e)										

NET EMISSIONS SUMMARY

NAME OF CITY:	Houston, USA	**POPULATION:**	2,239,558
BOUNDARY:	City / Municipality	**LAND AREA (km2):**	1,553
INVENTORY YEAR:	2014	**GDP (US$m):**	522,028

GHG Emissions Source (By Sector)		Total GHGs (metric tonnes CO2e)			Reductions (tCO2e)	Total net GHGs (metric tonnes CO2e)		
		Scope 1	Scope 2	Scope 3		BASIC	BASIC+	BASIC+ S3
STATIONARY ENERGY	**Energy use (all emissions except I.4.4)**	2,876,173	13,578,513			16,454,686	16,454,686	16,454,686
	Energy generation supplied to the grid (I.4.4)	419,308						
TRANSPORTATION	**(all II emissions)**	16,140,987				16,140,987	16,140,987	16,140,987
WASTE	**Waste generated in the city (III.X.1 and III.X.2)**	246,760		571,584		818,344	818,344	818,344
	Waste generated outside city (III.X.3)	482,861						
IPPU	**(all IV emissions)**							
AFOLU	**(all V emissions)**							
OTHER SCOPE 3	**(all VI emissions)**							
TOTAL		**20,166,089**	13,578,513	571,584	**Total reductions**	**33,414,017**	**33,414,017**	**33,414,017**