Green Technology Application for the Development of Low Carbon Cities (GTALCC)

City-wide GHG accounting

10 March 2021

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10 March 2021

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Module A: Inventory boundary

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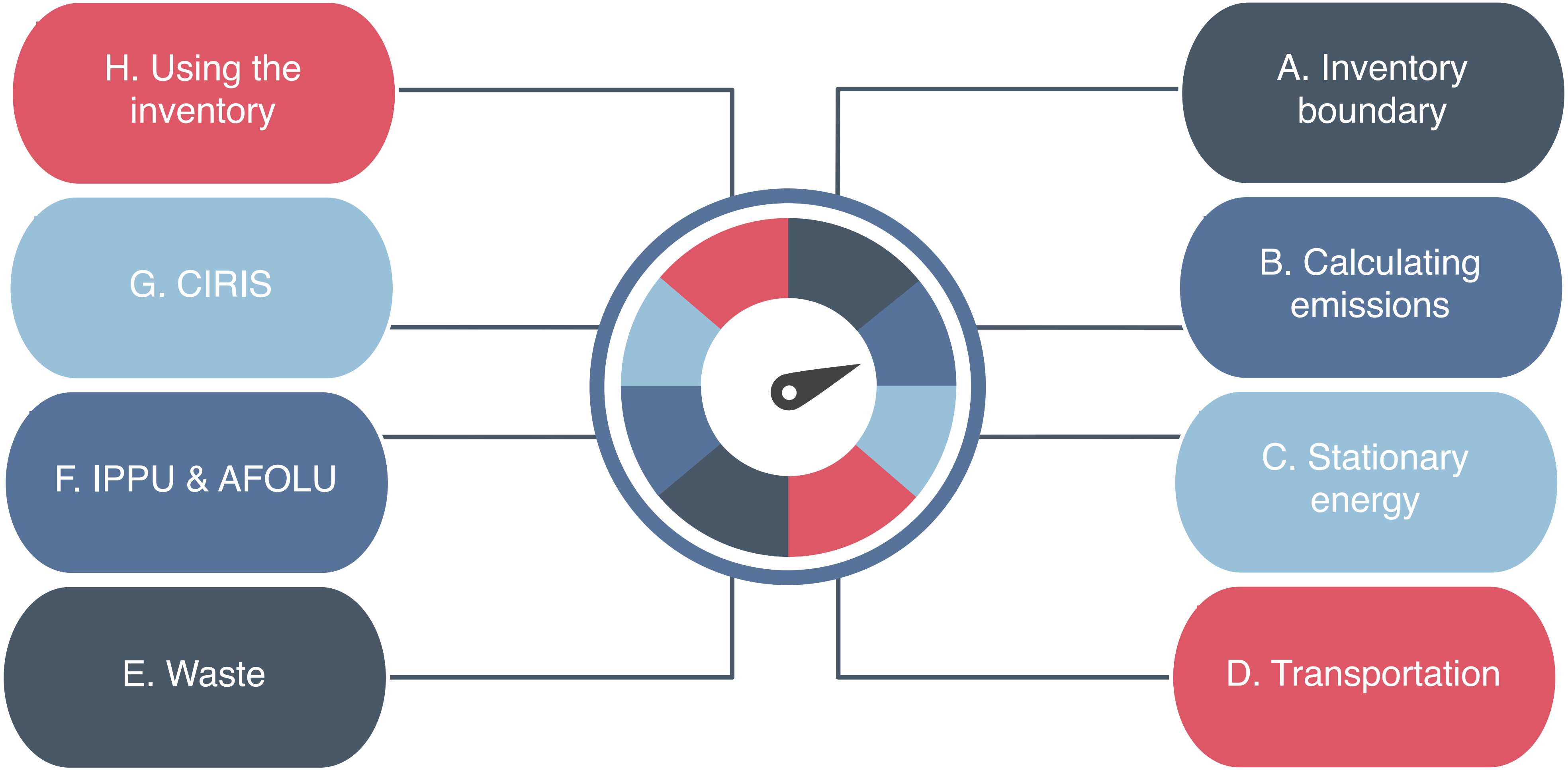
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GTALCC GHG Accounting - Participant handbook

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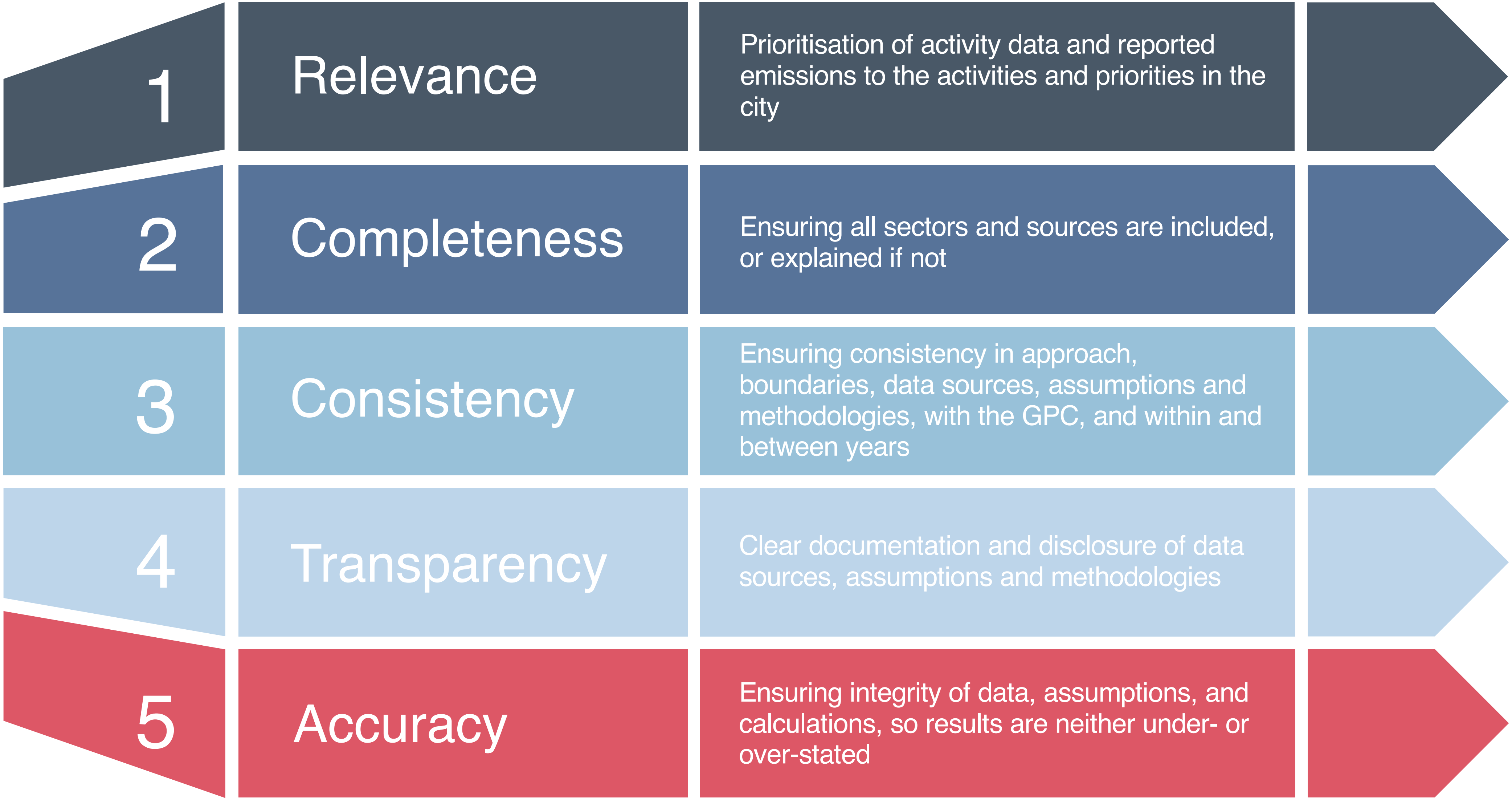
Module B

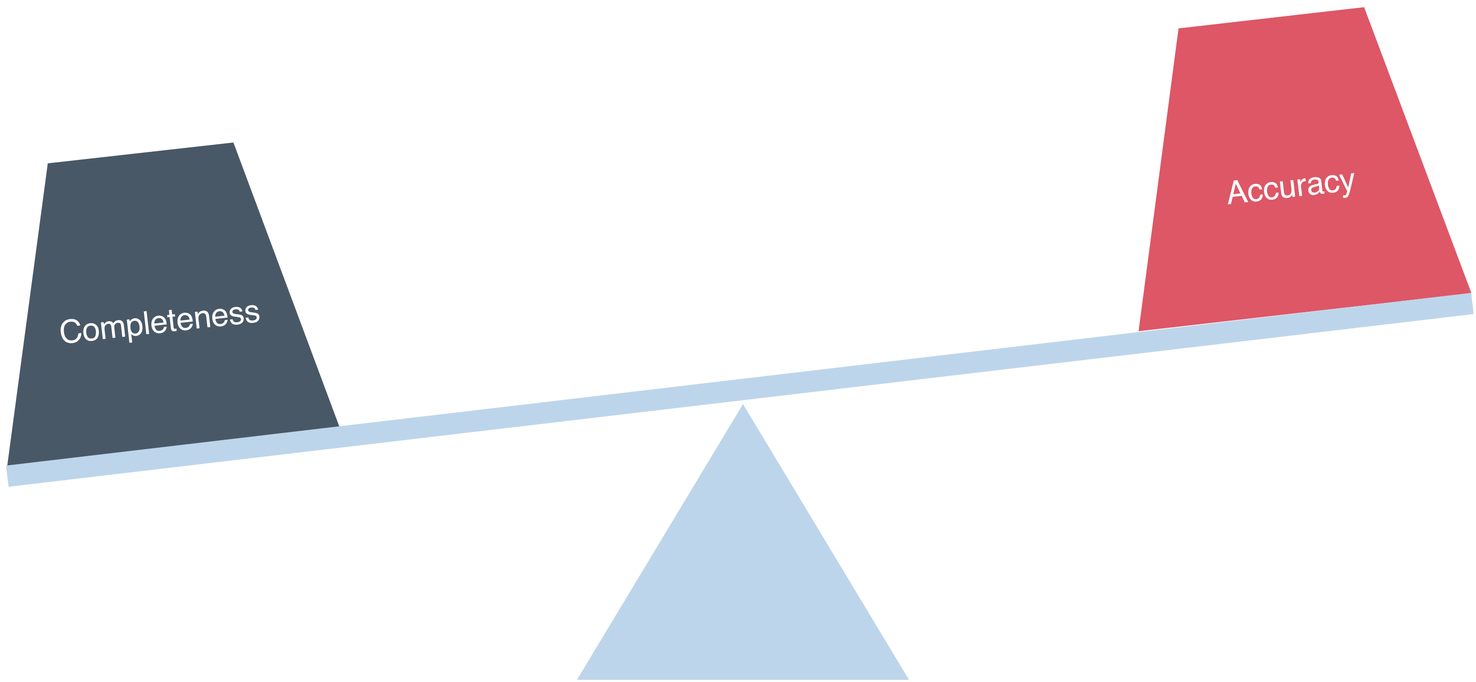
Calculating GHG emissions

01

Calculating GHG emissions


1
Relevance
Prioritisation of activity data and reported emissions to the activities and priorities in the city
2
Completeness
Ensuring all sectors and sources are included, or explained if not
3
Consistency
Ensuring consistency in approach, boundaries, data sources, assumptions and methodologies, with the GPC, and within and between years
4
Transparency
Clear documentation and disclosure of data sources, assumptions and methodologies
5
Accuracy
Ensuring integrity of data, assumptions, and calculations, so results are neither under- or over-stated

Balancing trade-offs between principles



Calculating GHG emissions

GHG emissions =

Activity data x emission factor

Activity data

A quantitative measure of a level of activity that results in GHG emissions taking place during a given period of time

Reliable and robust sources preferable

Time- and geographically-specific

Alternative approaches to obtaining city data are valid if clearly documented

Quantity of electricity used (kWh/year)

Volume of diesel sold at petrol stations (litres of fuel)

Amount of waste sent to landfill (tonnes of waste)

Emission factor

Emission factors convert activity data into a mass of GHG emissions

Emission factors represent the GHG emissions per unit of activity

Preference for geographically-specific factors from reliable and robust sources

IPCC default factors considered a robust alternative

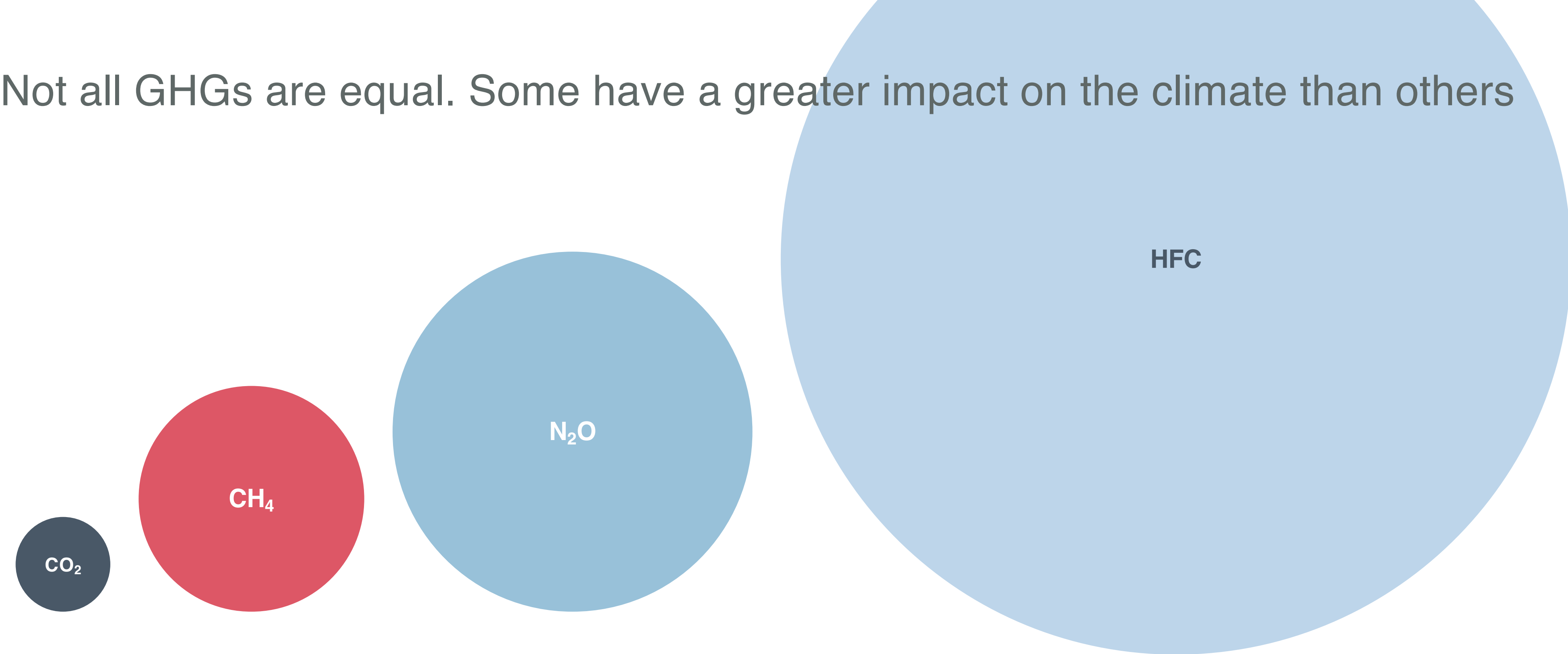
tonnes of CO_2e produced per kWh of electricity consumed

tonnes of CO_2e produced per litre of diesel consumed

tonnes of CO_2e produced per kilometre travelled

Global Warming Potential

Not all GHGs are equal. Some have a greater impact on the climate than others



To compare their impact, we use Global Warming Potential (or GWP) factors. A higher GWP indicates a greater impact on the climate

Global Warming Potential

All GHG emissions data must be reported as metric tonnes of each GHG, as well as **CO_2 equivalents** (CO_2e)

CO_2e 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 CO_2e 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

Which version does Malaysia use?

CO_2 equivalent (CO_2e)

$$CO_2e = GHG \times GWP$$

Assessment reports (AR)

GWP	CO_2	CH_4	N_2O
2AR	1	21	310
3AR	1	23	296
4AR	1	25	298
5AR	1	28	265

Source: https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf

Exercise: GWP

Activity	GWP	CO_2e
100,000 tonnes of CH_4	2AR	2,800,000 tCO_2e
100,000 tonnes of CH_4	5AR	2,100,000 tCO_2e
40 tonnes of CH_4 and 10 tonnes of N_2O	4AR	3,980 tCO_2e
10 tonnes of CH_4 and 40 tonnes of N_2O	3AR	12,070 tCO_2e
1,000,000 tonnes of CO_2	3AR	1,000,000 tCO_2eq
2 tonnes of SF_6 *(GWP=22,800)*	4AR	45,600 tCO_2e

$$CO_2e = GHG \times GWP$$

Units

CO2e is measured in (metric) tonnes

- 1 metric tonne = 1,000 kilos

Most inventories record emissions in **mega tonnes**, MtCO2e

- 1 mega tonne = 1 million tonnes

Prefix	Symbol	Multiplier	
giga	G	10^9	1,000,000,000
mega	M	10^6	1,000,000
kilo	k	10^3	1,000

From kilo to mega > divide by 1,000
From giga to mega > multiply by 1,000
From gigagramme (Gg) to a mega tonne > ?

Units	Symbol	Description
Kilowatt-hour	kWh	Unit of electricity
Megawatt	MW	Capacity of energy plant
Megajoule	MJ	Standard unit of energy
tonnes of oil equivalent	toe	Normalised unit of energy (used for primary fuels)

Stuck? Use a search engine

Note, (metric) tonne ≠ ton

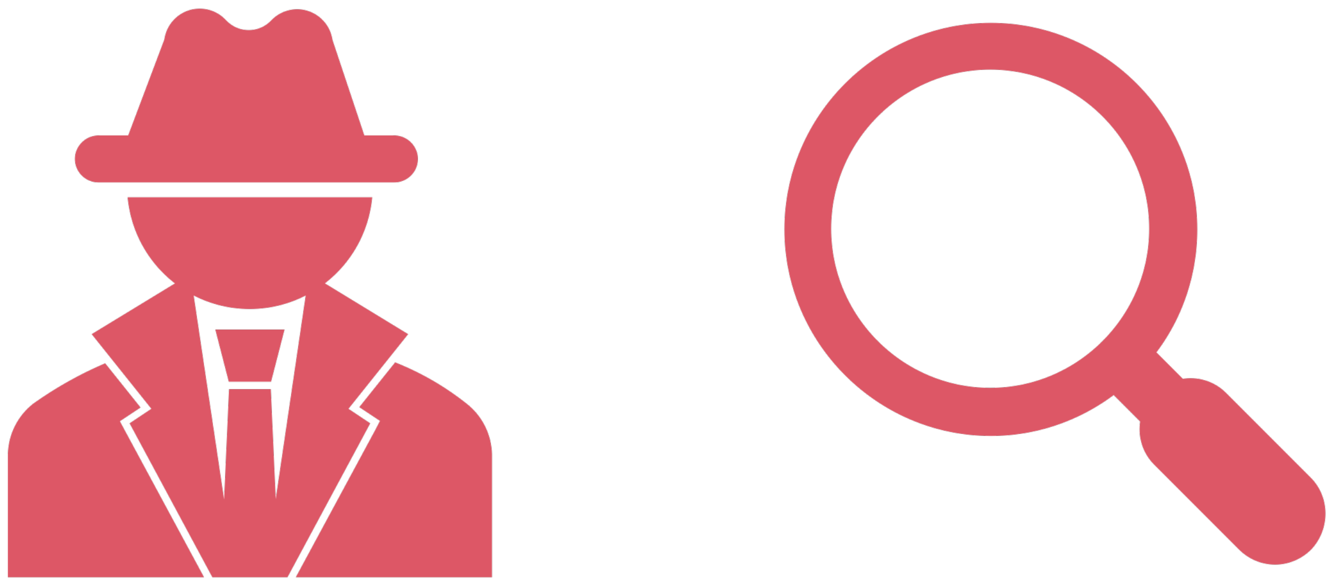
Module B

Calculating GHG emissions

02

Sourcing data

Sourcing data



List possible sources of activity data and emission factors?

Sourcing activity data

Source	Type of data
Government departments and statistics agencies	• Census data, city tax records • A country's **national greenhouse gas inventory report**
International organisations	• IPCC default assumptions • FAO statistics
Universities, research institutes and NGOs	• Local surveys, project reports • Scientific and technical articles in environmental books, journals and reports
Local utilities and service providers	• Waste contractor collection data • Metered consumption data
Sector experts / stakeholder groups / city government colleagues	• Reports, studies, databases • Their expertise
Online	• Google's Environmental Insights Explorer • Wikipedia
Yourself	• Your expertise

Data hierarchy

Data quality	Examples
High	• City-specific real-consumption/generation data, by sub-sector
Medium	• Modelled recent activity data using robust assumptions • Recent surveys
Low	• Highly modelled or uncertain activity data • Incomplete or aggregated data • Scaled regional or national data • Proxy data from similar cities/countries

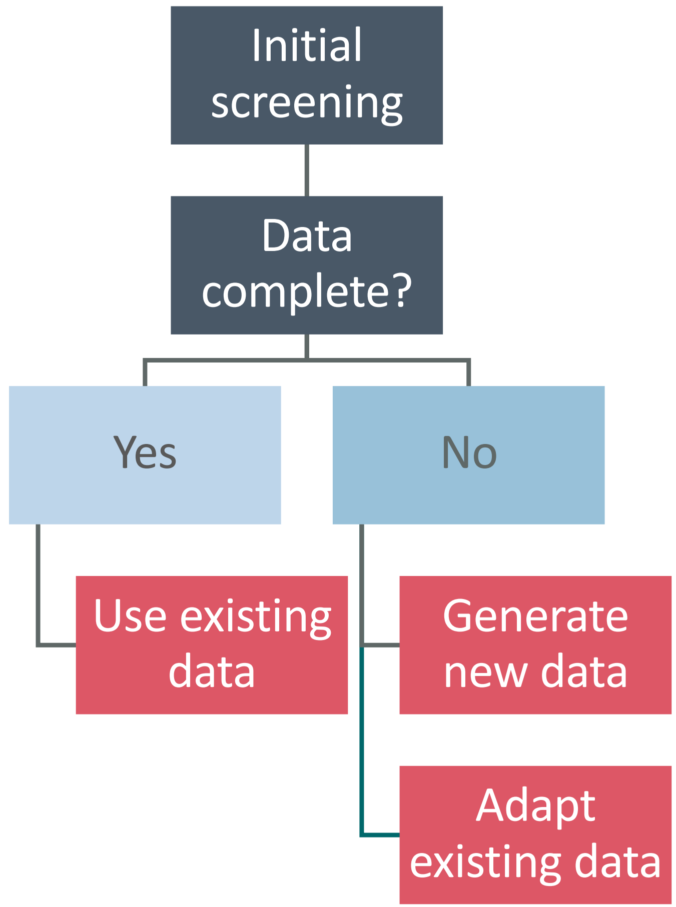
Selecting activity data

Data complete?

From reliable and robust sources

Time- and geographically-specific to the assessment boundary

Technology-specific to the activity being measured



Data collection process

Data collection process
Get familiar with the GPC
Set inventory boundaries for the city
Set reporting level
Identify reporting requirements for the corresponding reporting level
If the city has a previous inventory, identify differences and missing data
Identify data required by scope
Identify data required by sector & sub sector
Identify calculation methodologies to use considering available data
Identify local and national data sources
Understand and adjust data to local situation

Biennial Update Reports (BURs)

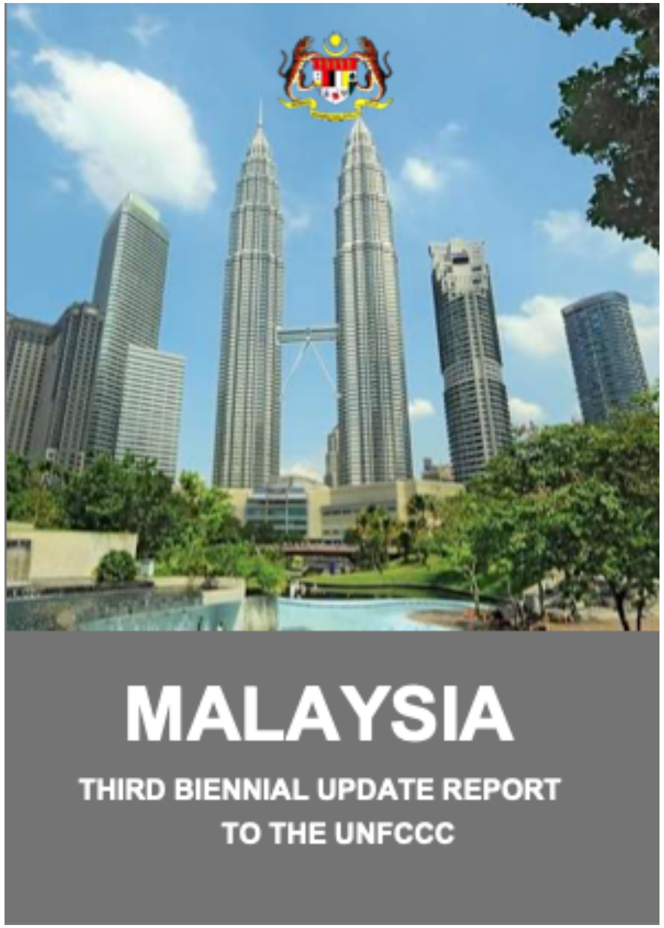
Every two years non-Annex I Parties to the United nations Framework Convention on Climate Change need to submit a **Biennial Update Report** (BUR).

BURs contain updates of **national GHG inventories**, including a national inventory report and information on mitigation actions, needs and support received.

Malaysia BUR1 – December 2015

Malaysia BUR2 – 27/09/2018

Malaysia BUR3 – 31/12/2020



Source: Malaysia Third Biennial Update Report to the UNFCCC

Biennial Update Reports #3

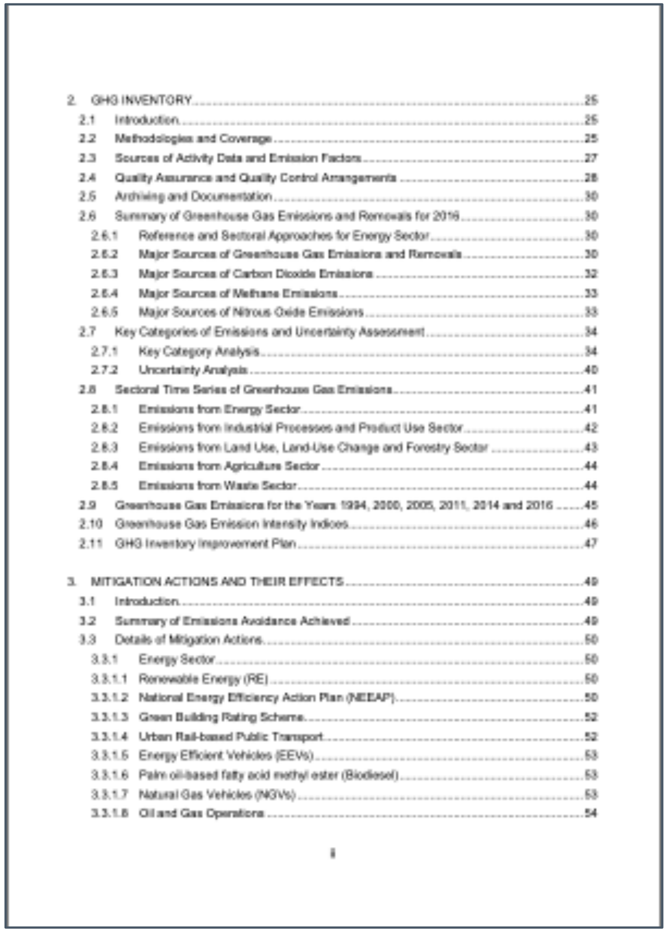
Sectors:

- Energy
- Waste
- Industrial processes and product used (IPPU)
- Agriculture forestry and other land use (AFOLU)

The inventory also contains time series estimates from 1990 to 2016 for each sector

Gases: CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 and NF_3

GWP from the IPCC 4th Assessment Report



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Source: Malaysia Third Biennial Update Report to the UNFCCC

Biennial Update Reports #3

2.3 Sources of Activity Data and Emission Factors

The mapping of methods and emission factors used, summary of emission factors and activity data/information are shown in Table A1, A2 and A3 respectively.

Most of the activity data for the calculations of the GHG inventory were derived from annual scheduled national publications. Where required, additional activity data were collected from the same source of data. International data were used when data at national level were not available. Consistency check was also undertaken between Malaysia activity data reported at national level and international databases.

For the Energy sector, the data was sourced from the National Energy Balance. Additional information for the energy data is obtained from the Energy Commission (the custodian of the National Energy Balance). Additional activity data from other government agencies and the private sector were obtained through official requests by the Ministry of Environment and Water to those entities.

For the Waste sector, activity data was obtained from the Department of Statistics Malaysia, annual publications from MPOB, Malaysian Rubber Board (MRB) and the National Energy Balance. Additional information was sourced from the relevant government agencies and industries.

Source: Malaysia Third Biennial Update Report to the UNFCCC

Biennial Update Reports #3

2.5 Archiving and Documentation

For each year of GHG inventory calculation, each of the sector's compilers generate a set of activity data, the database in the 2006 IPCC Guidelines software, external 2006 IPCC Guidelines spreadsheets and a sectoral report. Documentation of the procedures for the calculations and of the GHG Inventory team for each sector uses the United States Environmental Protection Agency (USEPA) templates.

For the archiving of the GHG Inventory, the 2006 IPCC software database and a flat file system for the external 2006 IPCC Guidelines spreadsheets were used for each of the five sectors (Energy, IPPU, Agriculture, LULUCF and Waste). This consists of three levels of files, which is the raw data file, the analysis files and the sectoral report file. The analysis files contain the 2006 IPCC Guidelines Software database and the 2006 IPCC Guidelines spreadsheets for each of the sectors.

The data files, 2006 IPCC Guidelines software database, analysis spreadsheets, reports and sectoral USEPA documentation templates are deposited with the GHG Inventory and Reporting Unit of the Ministry of Environment and Water. The agency heading each sectoral GHG inventory group also keeps a copy of their sectoral data files, analysis spreadsheets, reports and USEPA documentation templates as a second level backup.

Source: Malaysia Third Biennial Update Report to the UNFCCC

BUR3: GHG emissions

Table 2.4: Emissions and Removals of Greenhouse Gas for each Sector in 2016

Sector		Emissions/ Removals ($Gg\ CO_2$ eq.)	GWPs	CO_2 eq ($Gg\ CO_2$ eq.)
Energy (Reference Approach)	CO_2	235,881.971	1	235,881.97
Energy (Sectoral Approach)	CO_2 (from Fuel Combustion)	222,510.481	1	222,510.48
	CO_2 (from Fugitive Emissions)	1,942.147	1	1,942.15
	CH_4	1,037.704	25	25,942.60
	N_2O	4.362	298	1,299.79
Sub-total				**251,695.02**
Industrial Processes and Product Use	CO_2	20,807.763	1	20,807.76
	CH_4	13.523	25	338.08
	N_2O	0.237	298	70.70
	HFC-134a	0.4987728	1,430	713.25
	HFC-23 (CHF_3)	0.0029560	14,800	43.75
	PFC-14 (CF_4)	0.4889423	7,390	3,613.28
	PFC-116 (C_2F_6)	0.1090460	12,200	1,330.36
	PFC-218 (C_3F_8)	0.0036950	8,830	32.63
	SF_6	0.0152705	22,800	348.17
	NF_3	0.0029564	17,200	50.85
Sub-total				**27,348.83**
AFOLU –Agriculture	CO_2	531.828	1	531.83
	CH_4	165.957	25	4,148.93
	N_2O	19.956	298	5,946.96
Sub-total				**10,627.72**
AFOLU – LULUCF (Emissions)	CO_2	17,753.214	1	17,753.21
	CH_4	1.157	25	28.93
	N_2O	0.064	298	19.13
AFOLU – LULUCF (Removals)	CO_2	-259,146.025	1	-259,146.03
Sub-total				**-241,344.75**
Waste	CO_2	31.060	1	31.06
	CH_4	1,070.098	25	26,752.45
	N_2O	1.269	298	378.15
Sub-total				**27,161.66**
Total Emissions (Without LULUCF)				**316,833.23**
Total Emissions (With LULUCF emissions part only)				**334,634.51**
Total Emissions (With LULUCF)				**75,488.48**

Source: Malaysia Third Biennial Update Report to the UNFCCC

BUR3: GHG emissions

Table 2.5: Approach 1 Key Category Analysis of Greenhouse Gas Emissions for 2016, without Land Use, Land-Use Change and Forestry Emission

Sector	IPCC Category Code	IPCC Category Name	Gas	2016 estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
Energy	1.A.1	Energy Industries - Solid Fuels	CO_2	68,189.15	21.52%	21.52%
Energy	1.A.3.b	Road Transportation	CO_2	55,188.34	17.42%	38.94%
Energy	1.A.1	Energy Industries - Gaseous Fuels	CO_2	52,070.82	16.43%	55.38%
Energy	1.B.2.b	Fugitive Emissions from Fuels - Natural Gas	CH_4	24,446.89	7.72%	63.09%
Waste	4.D.2	Industrial Wastewater Treatment and Discharge	CH_4	13,927.93	4.40%	67.49%
Waste	4.A	Solid Waste Disposal	CH_4	11,214.23	3.54%	71.03%
Energy	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	10,896.28	3.44%	74.47%
Energy	1.A.1	Energy Industries - Liquid Fuels	CO_2	10,663.81	3.37%	77.83%
IPPU	2.A.1	Cement Production	CO_2	9,125.90	2.88%	80.71%
Energy	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CO_2	6,795.19	2.14%	82.86%
Energy	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	6,164.27	1.95%	84.80%
Energy	1.A.3.d	Transport - Water-borne Navigation - Liquid Fuels	CO_2	5,505.04	1.74%	86.54%
Energy	1.A.4	Other Sectors - Liquid Fuels	CO_2	5,260.26	1.66%	88.20%
IPPU	2.A.4	Other Process Uses of Carbonates -	CO_2	4,184.05	1.32%	89.52%

Sector	IPCC Category Code	IPCC Category Name	Gas	2016 estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
		Limestone and Dolomite				
AFOLU-Agriculture	3.C.4	Direct N_2O Emissions from Managed Soils	N_2O	4,052.61	1.28%	90.80%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CO_2	3,583.40	1.13%	91.93%
AFOLU-Agriculture	3.C.7	Rice Cultivations	CH_4	2,265.20	0.71%	92.65%
IPPU	2.C.3	Aluminium Production	PFC-14	2,246.56	0.71%	93.36%
Energy	1.B.2.a	Fugitive Emissions from Fuel - Oil	CO_2	1,846.14	0.58%	93.94%
Waste	4.D.1	Domestic Wastewater Treatment and Discharge	CH_4	1,608.12	0.51%	94.45%
IPPU	2.C.1	Iron and Steel Production	CO_2	1,384.51	0.44%	94.88%
AFOLU-Agriculture	3.A.1	Enteric Fermentation	CH_4	1,370.44	0.43%	95.31%

Note: No electricity consumption. National government inventories do not report scope 2 emissions. Fossil fuels used for electricity generation are reported under Energy Industries.

Source: Malaysia Third Biennial Update Report to the UNFCCC

BUR3: Key statistics

Table 1.15: Key Statistics for 2005 and 2016

Year	2005	2016
Latitude	0º 51' N - 7º 33' N	
Longitude	98º 01' E – 1 9º 30' E	
Area	330,345 km^2	
Coastline	8,840 km	
Mean daily temperature	26 – 28 ^{o}C	
Average annual rainfall	2,000 – 4,000 mm	
Average daily direct sunlight	6 hours	
Forest Cover as % of total land area	53.9% (estimate)	55.5% (estimate)
Population	26.0 million	31.6 million
Population density	79 per km^2	96 per km^2
Female life expectancy	76.0 years	77.0 years
Male life expectancy	71.4 years	72.1 years
Age Profile	Below 15 years old – 30.9% 15 to 64 years old – 64.6% Above 65 years old – 4.5%	Below 15 years old – 24.5% 15 to 64 years old – 69.5% Above 65 years old – 6.0%
Urbanisation Rate	66.5%	74.8%
GDP (at 2010 constant prices)	RM 659,639 million	RM 1,108,900 million
GNI/capita (at 2010 constant prices)	RM 24,739	RM 37,822
Primary Energy Supply	66,211 ktoe	93,396 ktoe
Final Energy Demand	38,284 ktoe	57,218 ktoe
Total Electricity Consumption	73,987 GWh	116,529 GWh
Length of roads (Federal and State)	88,528 km	236,802 km
Motor vehicle registration	14,816,407	27,613,259
Annual Ridership on urban rail network in Greater Kuala Lumpur/ Klang Valley (passenger journeys)	157,475,402	210,498,247
Public transport modal share in Greater Kuala Lumpur/ Klang Valley	-	20%
Annual ridership on Stages Buses (11 towns and cities) (passenger journeys)	-	46,915
Solid Waste	-	33,130 tonnes/day (2012)

Source: Malaysia Third Biennial Update Report to the UNFCCC

BUR3: Emission factors

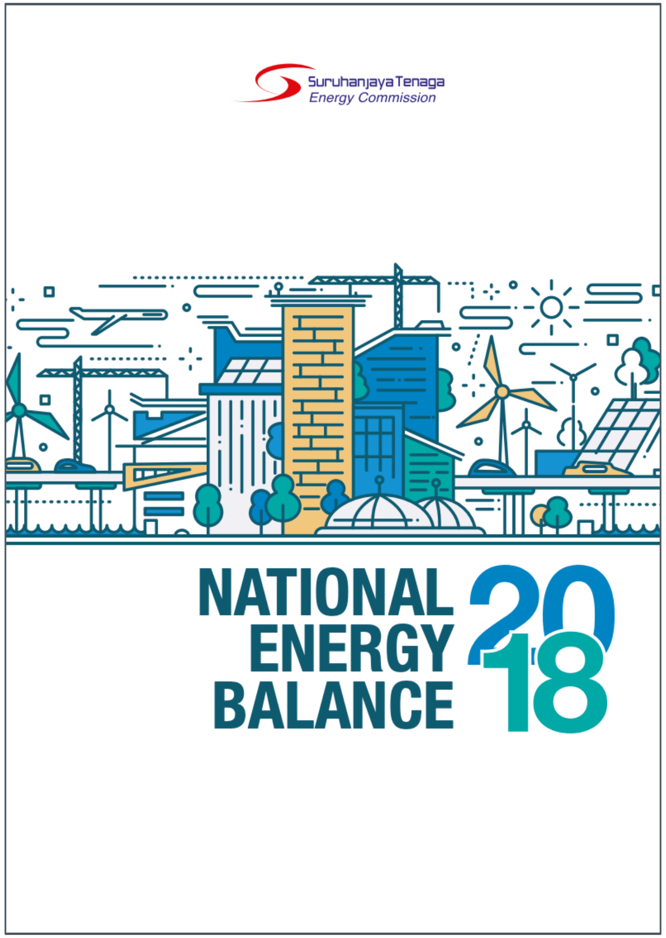
Table A2: Summary of Emission Factors Used

		Emission factors								
		CO_2 (tC/TJ)	CH_4 (kg/TJ)	N_2O (kg/TJ)	HFCs	PFCs	SF_6	NF_3	NO_x	CO
ENERGY										
1A Fuel Combustion Activities										
1A1 Energy Industries										
1A1a	Electricity and Heat Production									
1A1ai	Electricity Generation									
	Diesel oil	20.2	3	0.6						
	Residual Fuel Oil	21.1	3	0.6						
	Sub-bituminous coal	26.2	1	1.5						
	Natural Gas	15.3	1	0.1						
1A1 b	Petroleum Refining									
	Crudel oil	20.0	3	0.6						
1A1 c	Manufacture of Solid Fuels and Other Energy Industries									
	Natural gas	15.3	1	0.1						
1A2 Manufacturing Industries and Construction										
	Gasoline	18.9	3	0.6						
	Other kerosene	19.6	3	0.6						
	Diesel oil	20.2	3	0.6						
	Residual Fuel Oil	21.1	3	0.6						
	LPG	17.2	1	0.1						
	Sub-bituminous coal	26.2	10	1.5						
	Natural gas	15.3	1	0.1						
1A3 Transport										
1A3 a	Civil Aviation									
1A3 aii	Domestic Aviation									
	Jet kerosene	19.5	0.5	2						
1A3 b	Road Transportation									
	Natural gas	15.3	92	3						
	Gasoline	18.9	33	3.2						
	Diesel Oil	20.2	3.9	3.9						
1A3 c	Railways									
	Diesel Oil	20.2	4.15	28.6						
1A3 d	Water-borne Navigation									
1A3 dii	Domestic Water-borne Navigation									
	Diesel Oil	20.2	7	2						
	Residual Fuel Oil	21.1	7	2						
1A4 Other Sectors										
1A4 a	Commercial/Institutional									
	Diesel Oil	20.2	10	0.6						
	Residual Fuel Oil	21.1	10	0.6						
	LPG	17.2	5	0.1						
	Natural Gas	15.3	5	0.1						
1A4 b	Residential									
	Other kerosene	19.6	10	0.6						
	LPG	17.2	5	0.1						
	Natural Gas	15.3	5	0.1						
1A4 c	Agriculture/Forestry/Fishing/Fish Farms									
1A4 ci	Stationary									
	Diesel Oil	20.2	10	0.6						
	Residual Fuel Oil	21.1	10	0.6						
1A4 cii	Off-road Vehicles and Other Machinery									
1A4 ciii	Fishing (mobile combustion)									
	Diesel Oil	20.2	5	0.6						
	Residual Fuel Oil	21.1	5	0.6						
1A5 Non-Specified										
1A5 a	Stationary									

Source: Malaysia Third Biennial Update Report to the UNFCCC

National Energy Balance (NEB)

Every year, the Malaysia Energy Information Hub (MEIH), managed by the Energy Commission (EC) of Malaysia publishes the **National Energy Balance** (NEB) which provides data on the supply and consumption of energy in Malaysia.



Source: https://meih.st.gov.my/documents/10620/f2f4c39b-4748-4c5d-b90a-fc36ba880264

National Energy Balance (NEB)

TABLE 1: KEY ECONOMIC AND ENERGY DATA

	2018				
	1Q	2Q	3Q	4Q	Total
GDP at current prices (RM million) *	346,708	353,821	367,778	379,145	**1,447,451**
GDP at 2015 prices (RM million) *	326,800	332,254	345,329	357,432	**1,362,815**
GNI at current prices (RM million) *	338,406	343,128	353,729	367,106	**1,402,369**
Population ('000 people) **	32,292	32,382	32,432	32,482	**32,382**
Primary Energy Supply (ktoe)	24,273	24,698	25,246	25,656	**99,873**
Final Energy Consumption (ktoe)	16,409	15,649	16,003	16,597	**64,658**
Electricity Consumption (ktoe)	3,176	3,323	3,355	3,300	**13,153**
Electricity Consumption (GWh)	36,912	38,615	38,987	38,352	**152,866**
Per Capita					
GDP at Current Prices (RM)*	42,496	43,705	45,360	46,690	**44,699**
Primary Energy Supply (toe)	0.752	0.763	0.777	0.788	**3.084**
Final Energy Consumption (toe)	0.508	0.483	0.493	0.510	**1.997**
Electricity Consumption (kWh)	1,143	1,192	1,202	1,181	**4,721**
Energy Intensity					
Primary Energy Supply (toe/GDP at 2015 prices (RM million))	74.27	74.11	73.11	71.78	**73.28**
Final Energy Consumption (toe/GDP at 2015 prices (RM million))	50.2	47.0	46.3	46.4	**47.4**
Electricity Consumption (toe/GDP at 2015 prices (RM million))	9.7	10.0	9.7	9.2	**9.7**
Electricity Consumption (GWh/GDP at 2015 prices (RM million))	0.113	0.116	0.113	0.107	**0.112**

Note (*) : Quarterly data is from the Department of Statistics Malaysia
(**) : Mid-year population data is from the Department of Statistics Malaysia

TABLE 2: KEY ECONOMIC AND ENERGY DATA BY REGION

Peninsular Malaysia	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GDP at Current Prices (RM million) *	516,321	571,945	651,915	610,691	684,057	751,734	806,569	849,891	925,232	975,581	1,038,585	1,131,564	1,193,179
GDP at 2015 Prices (RM million) *	628,560	667,980	701,990	688,320	744,624	784,737	833,245	873,486	928,517	975,581	1,020,869	1,079,978	1,137,741
Population ('000 people) **	21,180	21,577	21,970	22,363	22,753	23,099	23,417	23,868	24,281	24,669	24,995	25,303	25,593
Final Energy Consumption (ktoe)	34,390	37,921	38,530	34,521	35,593	35,968	36,683	41,859	42,470	43,011	45,872	46,520	47,446
Electricity Consumption (ktoe)	6,669	7,030	7,307	7,567	8,145	8,427	8,791	9,108	9,315	9,531	10,026	10,004	10,378
Electricity Consumption (GWh)	77,504	81,710	84,924	87,950	94,666	97,939	102,174	105,861	108,259	110,770	116,529	116,272	120,617
Per Capita													
GDP at Current Prices (RM)*	24,378	26,508	29,674	27,308	30,064	32,544	34,444	35,608	38,105	39,547	41,551	44,721	46,621
Final Energy Consumption (toe)	1.624	1.757	1.754	1.544	1.564	1.557	1.567	1.754	1.749	1.744	1.835	1.839	1.854
Electricity Consumption (kWh)	3,659	3,787	3,866	3,933	4,161	4,240	4,363	4,435	4,459	4,490	4,662	4,595	4,713
Energy Intensity													
Final Energy Consumption (toe/GDP at 2015 prices (RM million))	54.7	56.8	54.9	50.2	47.8	45.8	44.0	47.9	45.7	44.1	44.9	43.1	41.7
Electricity Consumption (toe/GDP at 2015 prices (RM million))	10.6	10.5	10.4	11.0	10.9	10.7	10.6	10.4	10.0	9.8	9.8	9.3	9.1
Electricity Consumption (GWh/GDP at 2015 prices (RM million))	0.123	0.122	0.121	0.128	0.127	0.125	0.123	0.121	0.117	0.114	0.114	0.108	0.106

Note (*): 1. GDP data by State is from the Department of Statistics Malaysia
2. GDP for Peninsular Malaysia including Supra State (Supra State covers production activities that beyond the centre of predominant economic interest for any state)
3. GDP data by State from 2006 until 2014 were estimated by the Energy Commission
(**): Mid-year population is from the Department of Statistics Malaysia

Source: https://meih.st.gov.my/documents/10620/f2f4c39b-4748-4c5d-b90a-fc36ba880264

Other data sources

Examples
• Environmental Insights Explorer
• GPC interactive dashboard
• UK emission factors database

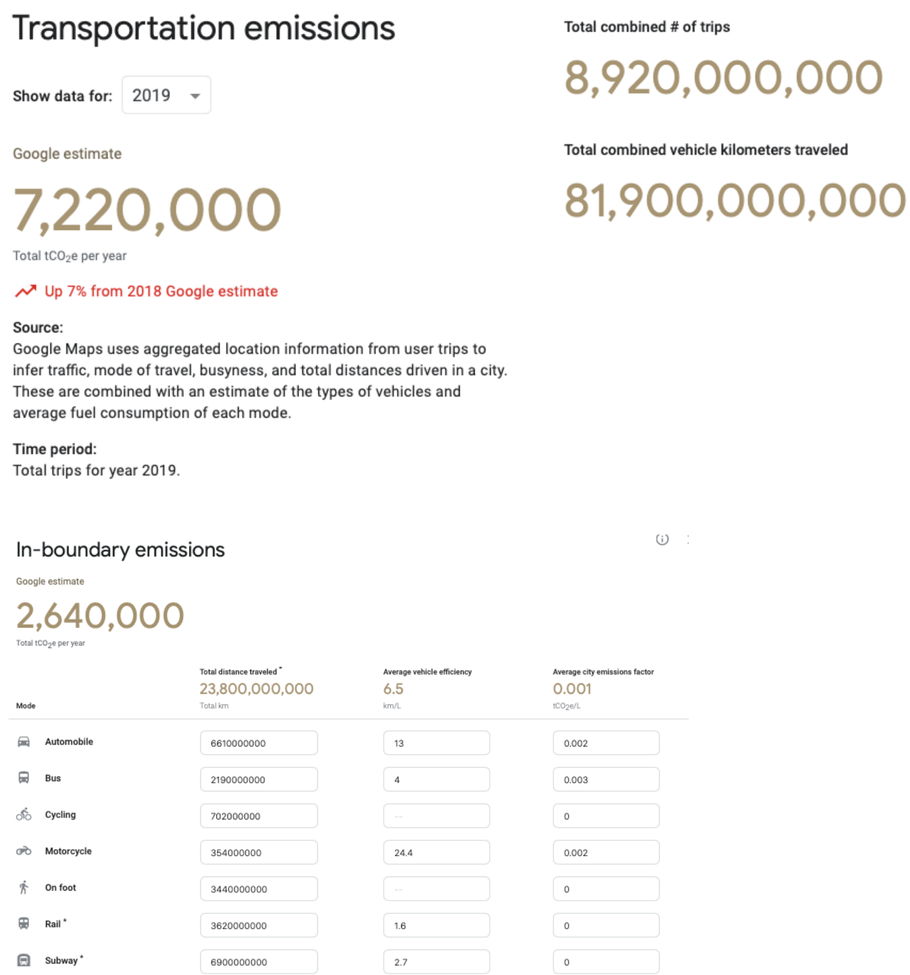
Environmental Insights Explorer

Provides access to Google's mapping data and ML capabilities

- Buildings
- Transportation
- Rooftop solar potential

But …

- Does not cover all cities
- Requires access
- May not calibrate well with other estimations



Source: https://insights.sustainability.google

GPC interactive dashboard

All GPC inventories from C40 cities

- GHG data only
- Allows for comparison

	Scope 1	Scope 2	Scope 3
Kuala Lumpur	**15,548,891**	**8,969,058**	**576,105**
Stationary	**1,472,306**	**8,882,384**	**0**
Residential buildings	182,833	2,365,581	0
Commercial and institutional building and facilities	174,796	5,857,396	0
Manufacturing industries and construction	1,031,904	659,407	0
Energy industries	0	0	0
Agriculture, forestry and fishing activities	0	0	0
Non-specified sources	0	0	0
Fugitive emissions from mining, processing, storage and transportation of coal	0	0	0
Fugitive emissions from oil and natural gas systems	82,773	0	0
Transport	**13,875,481**	**86,674**	**0**
On-road transportation	13,875,481	0	0
Railways	0	86,674	0
Waterborne navigation	0	0	0
Aviation	0	0	0
Off-road transportation	0	0	0
Waste	**201,104**	**0**	**576,105**
Solid waste disposal	0	0	572,481
Biological treatment of waste	0	0	1,355
Incineration and open burning	0	0	2,269
Wastewater treatment and discharge	201,104	0	0

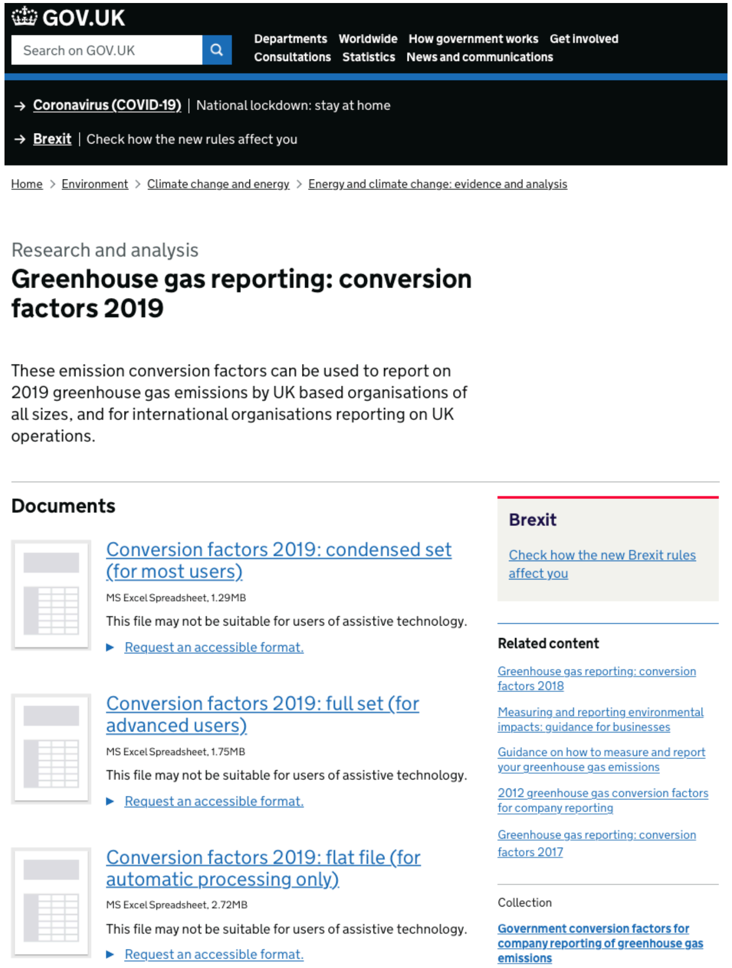
Source: https://www.c40knowledgehub.org/s/article/C40-cities-greenhouse-gas-emissions-interactive-dashboard?language=en_US

UK emission factors database

Comprehensive database of emission factors designed for UK based organisations, and for international organisations reporting on UK operations. Useful for

- Primary fuels
- Proxy data

Activity	Fuel	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Gaseous fuels	CNG	tonnes	2542,04	2537,36	3,34	1,34
		litres	0,44486	0,44404	0,00058	0,00023
		kWh (Net CV)	0,20428	0,20390	0,00027	0,00011
		kWh (Gross CV)	0,18385	0,18351	0,00024	0,00010
	LNG	tonnes	2550,04	2545,37	3,34	1,34
		litres	1,15387	1,15175	0,00151	0,00060
		kWh (Net CV)	0,20492	0,20455	0,00027	0,00011
		kWh (Gross CV)	0,18443	0,18409	0,00024	0,00010
	LPG	tonnes	2936,86	2933,01	1,94	1,91
		litres	1,52260	1,52060	0,00101	0,00099
		kWh (Net CV)	0,23029	0,22999	0,00015	0,00015
		kWh (Gross CV)	0,21447	0,21419	0,00014	0,00014
	Natural gas	tonnes	2542,04	2537,36	3,34	1,34
		cubic metres	2,03053	2,02680	0,00267	0,00107
		kWh (Net CV)	0,20428	0,20390	0,00027	0,00011
		kWh (Gross CV)	0,18385	0,18351	0,00024	0,00010
	Natural gas (100% mineral blend)	tonnes	2550,04	2545,37	3,34	1,34
		cubic metres	2,03693	2,03320	0,00267	0,00107
		kWh (Net CV)	0,20492	0,20455	0,00027	0,00011
		kWh (Gross CV)	0,18443	0,18409	0,00024	0,00010
	Other petroleum gas	tonnes	2610,26	2607,71	1,17	1,39
		litres	0,95614	0,95521	0,00043	0,00051
		kWh (Net CV)	0,20164	0,20145	0,00009	0,00011
		kWh (Gross CV)	0,18551	0,18533	0,00008	0,00010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Research and analysis

Greenhouse gas reporting: conversion factors 2019

These emission conversion factors can be used to report on 2019 greenhouse gas emissions by UK based organisations of all sizes, and for international organisations reporting on UK operations.

Documents

Conversion factors 2019: condensed set (for most users)
MS Excel Spreadsheet, 1.29MB
This file may not be suitable for users of assistive technology.
Request an accessible format.

Conversion factors 2019: full set (for advanced users)
MS Excel Spreadsheet, 1.75MB
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Conversion factors 2019: flat file (for automatic processing only)
MS Excel Spreadsheet, 2.72MB
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Brexit
Check how the new Brexit rules affect you

Related content
Greenhouse gas reporting: conversion factors 2018
Measuring and reporting environmental impacts: guidance for businesses
Guidance on how to measure and report your greenhouse gas emissions
2012 greenhouse gas conversion factors for company reporting
Greenhouse gas reporting: conversion factors 2017

Collection
Government conversion factors for company reporting of greenhouse gas emissions

Source: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2019

Referencing data sources

Activity data from National Energy Balance 2017 report, Table 3.3	Expert judgement
Emission factors from Malaysia's Biennial Update Report 3 to the UNFCCC	IPCC emission factor (2006 IPCC Guidelines)
Email exchange with Ministry of Environment	Departmental reports
Proxy data from Jakarta's GPC inventory	Wikipedia (*provide URL*)

Module B

Calculating GHG emissions

03

Dealing with data challenges

Good data in = good data out

List some of the typical data challenges cities commonly face

Good data in = good data out

Typical challenges faced by cities:

- Data providers give you ‘what we have’ not ‘what you need’
- Judging the quality of data provided – is it any good?
- Transparency of data provided – understanding what you have been provided with and how it has been compiled
- Timescales to obtain data
- ‘Knocking on doors’ with no progress
- Not knowing the right people to ask
- Data providers won’t share (information is power)
- Cost of data / payments for data
- Simple lack of data – alternative approaches needed

Incomplete datasets are not uncommon

"We have data, but it's not broken down by vehicle type"

"The data covers neighbouring cities in the region as well?"

"The transport team tell me we don't collect the data I need"

"We last carried out a transport survey in 2010"

Examples of incomplete data

- Gaps in periodic data
- Recent data not yet available
- Confidentiality
- Only country-level data available
- Data do not align with city boundary
- Data only available for part of city or part of year

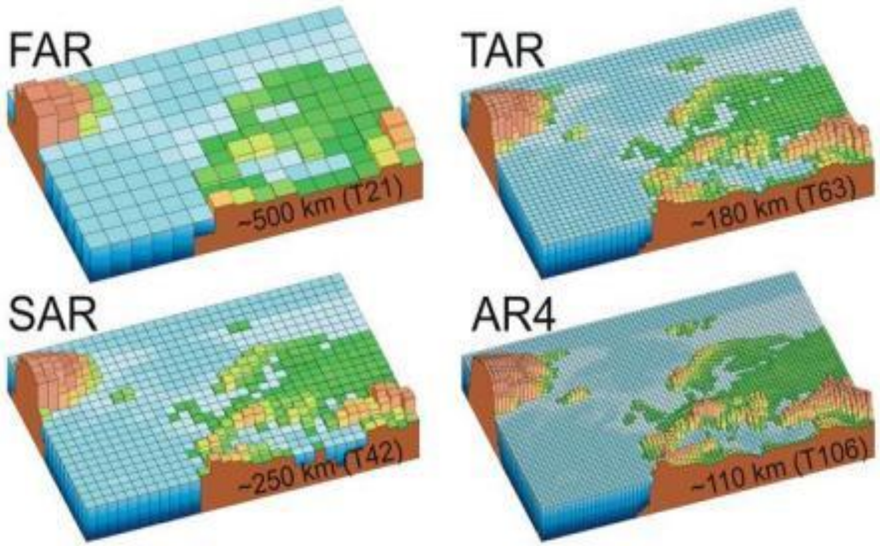
Making the most of limited data

Aim for completeness over accuracy: start with whatever data you have and improve over time

Do not be afraid to use data that is incomplete – e.g. has gaps, is old or does not provide total coverage – as long as you understand the issues

Many techniques exist to make the data meet inventory requirements

Data availability, range, quality, accuracy often improve over time



Source: www.wmo.int/pages/themes/climate/climate_models.php

Data-filling techniques

Approach	Applicability	Comments
Proxy data (Scaling factor)	Missing data is strongly correlated with proxy data	Should test multiple potential proxy data variables
Overlap	Consistent relationship between two datasets	Only use when overlap shows pattern that appears reliable
Interpolation	For periodic data or gap in time series	Linear or non-linear interpolation. Only use where data shows steady trend
Extrapolation	Beginning or the end of the time series is missing data	Only use where trend is steady and likely to be reliable. Should only be used for a very few years

Data-filling techniques

Approach	
Proxy data (Scaling factor)	
Overlap	
Interpolation	
Extrapolation	

Proxy data approach

Proxy data can be useful and relevant where data for the inventory year or other aspect of the inventory boundary is unavailable or incomplete

The proxy data approach uses a scaling factor which represents the ratio between the available data and the required inventory data and should reflect a high degree of correlation to variations in the data

Inventory data = available data * scaling factor

$$\text{Where scaling factor} = \frac{\text{Proxy data inventory data (e.g. population city)}}{\text{Proxy data available data (e.g. population country)}}$$

Proxy data approach

Population is one of the most common factors used to scale data because, in the absence of major technological and behavioural changes, the number of people is a key driver of GHG emissions, particularly in the residential sector.

Other proxy data may include:

- GDP/ output data
- Employment statistics (by sector)
- Household expenditure
- Number of buildings / floor are of buildings
- Land area

Proxy data approach

Missing electricity data for inventory year but have data for previous years

Target	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
MWh electricity				8762					7891	?

Proxy data approach

Step 1: Identify proxy variable (population) and record data

Target	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
MWh electricity				8762					7891	?

Proxy	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Population (1,000)	4.16	4.20	4.19	4.21	4.22	4.25	4.27	4.29	4.32	4.31

Note, there has to be plausible relationship between the target and proxy variable

Proxy data approach

Step 2: Calculate scaling factor (2016 = 7891 / 4.32 = 1826.6)

Target	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
MWh electricity				8762					7891	?

Proxy	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Population (1,000)	4.16	4.20	4.19	4.21	4.22	4.25	4.27	4.29	4.32	4.31

Scaling factor (MWh / 1000 people)				2081.2					1826.6	

Proxy data approach

Step 3: Back fill target data (2017 = 4.31 * 1826.6 = 7873)

Target	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
MWh electricity				8762					7891	7873

Proxy	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Population (1,000)	4.16	4.20	4.19	4.21	4.22	4.25	4.27	4.29	4.32	4.31

Scaling factor (MWh / 1000 people)				2081.2					1826.6	1826.6

Proxy data approach: examples

Wellington Region, New Zealand

- Consumption of coal, wood and biomass estimated using national average emission figures and allocated on a population basis

- Wastewater volumes estimated based on population figures and average New Zealand wastewater generation per person

Johannesburg, South Africa

- Number of households using coal for cooking and heating was based on regional community survey for 2011. The same proportion was applied to Johannesburg for 2007

Exercise: Proxy data

Estimate GHG emissions from waste sent to landfill for your city using the **proxy data** approach:

1. Find a good proxy city with data

2. Identify a suitable scaling factor

3. Multiply the the proxy data by the scaling factor

Assume Kuala Lumpur makes a good proxy city. Use the data on the next slide from Kuala Lumpur’s 2017 GPC inventory to estimate GHG emissions from (1) solid waste disposal, (2) biological treatment of waste, (3) incineration / open burning and (4) wastewater treatment for your city

Exercise: Proxy data

CITY	INVENTORY YEAR	POPULATION	GDP (MILLION USD)	AREA (KM2)
Kuala Lumpur (Malaysia)	2017	1,793,000	52,097	243

	Scope 1	Scope 2	Scope 3
Kuala Lumpur	**15,548,891**	**8,969,058**	**576,105**
Stationary	**1,472,306**	**8,882,384**	**0**
Residential buildings	182,833	2,365,581	0
Commercial and institutional building and facilities	174,796	5,857,396	0
Manufacturing industries and construction	1,031,904	659,407	0
Energy industries	0	0	0
Agriculture, forestry and fishing activities	0	0	0
Non-specified sources	0	0	0
Fugitive emissions from mining, processing, storage and transportation of coal	0	0	0
Fugitive emissions from oil and natural gas systems	82,773	0	0
Transport	**13,875,481**	**86,674**	**0**
On-road transportation	13,875,481	0	0
Railways	0	86,674	0
Waterborne navigation	0	0	0
Aviation	0	0	0
Off-road transportation	0	0	0
Waste	**201,104**	**0**	**576,105**
Solid waste disposal	0	0	572,481
Biological treatment of waste	0	0	1,355
Incineration and open burning	0	0	2,269
Wastewater treatment and discharge	201,104	0	0

Exercise: Proxy data

CITY	INVENTORY YEAR	POPULATION	GDP (MILLION USD)	AREA (KM2)
Kuala Lumpur (Malaysia)	2017	1,793,000	52,097	243

Potential scaling factors

	Scope 1	Scope 2	Scope 3
Kuala Lumpur	15,548,891	8,969,058	576,105
Stationary	1,472,306	8,882,384	0
Residential buildings	182,833	2,365,581	0
Commercial and institutional building and facilities	174,796	[illegible]	0
[illegible]	[illegible]	659,407	0
Energy industries	0	0	0
Agriculture, forestry and fishing activities	0	0	0
Non-specified sources	0	0	0
Fugitive emissions from mining, processing, storage and transportation of coal	0	0	0
Fugitive emissions from oil and natural gas systems	82,773	0	0
Transport	13,875,481	86,674	0
On-road transportation	13,875,481	0	0
Railways	0	86,674	0
Waterborne navigation	0	0	0
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Off-road transportation	0	0	0
Waste	201,104	0	576,105
Solid waste disposal	0	0	572,481
Biological treatment of waste	0	0	1,355
Incineration and open burning	0	0	2,269
Wastewater treatment and discharge	201,104	0	0

Proxy data

$$\text{GHG from solid waste disposal} = \text{GHG from solid waste disposal in KL} * \frac{\text{Your population / GDP / Area}}{\text{KL population / GDP / Area}}$$

Workbook

GTALCC GHG Accounting - Participant handbook

Exercises	
Module B	Calculating GHG emissions
	Reviewing an inventory
Module C	Stationary energy
Module D	Transportation
Module E	Waste
Module F	IPPU and AFOLU

Tables	
Table 1	GHG emission sources
Table 2	Fuel types
Table 3	GPC
Table 4	Action plan

Reference
GPC
GWP
Notation keys
Checklist

Workbook

Module B: Calculating GHG emissions

1. Estimate GHG emissions for all waste sub-sectors for your city by scaling reported data from Kuala Lumpur's 2017 GPC inventory

Solid waste disposal		Biological treatment		Incineration		Wastewater	
KL: tonnes of CO2e	572.481	KL: tonnes of CO2e	1.355	KL: tonnes of CO2e	2.269	KL: tonnes of CO2e	201.104
KL: population		KL: population		KL: population		KL: population	
City: population		City: population		City: population		City: population	
Tonnes of CO2e		**Tonnes of CO2e**		**Tonnes of CO2e**		**Tonnes of CO2e**	

Exercise: Proxy data

GTALCC City	Population	Solid waste disposal	Biological treatment	Incineration / open burning	Wastewater treatment
Perbadanan Putrajaya					
Hang Tuah Java					
Petaling Jaya					
Sepang					
Iskandar RDA					
Another city					

GHG from solid waste disposal =

$$\text{GHG from solid waste disposal in KL (? tCO2e)} * \frac{\text{Your population (?)}}{\text{KL population (?)}} = \text{? tCO2e}$$

Exercise: Proxy data

GTALCC City	Population	Solid waste disposal	Biological treatment	Incineration / open burning	Wastewater treatment
Perbadanan Putrajaya					
Hang Tuah Java					
Petaling Jaya					
Sepang					
Iskandar RDA					
Another city	1,000,000	319,287	756	1,265	112,161

GHG from solid waste disposal =

$$\text{GHG from solid waste disposal in KL (572,481 tCO2e)} * \frac{\text{Your population (1,000,000)}}{\text{KL population (1,793,000)}} = 319,287\ \text{tCO2e}$$

Congratulations

Exercise: Scaling factor

Activity	Methodology
Emission from commercial air conditioning	Number of vehicles
Emissions from domestic refrigeration	GDP
Emissions from on-road transportation	Population
Emissions steel production	Floor area by building type

Data-filling techniques

Approach	
Proxy data (Scaling factor)	✓
Overlap	▶
Interpolation	
Extrapolation	

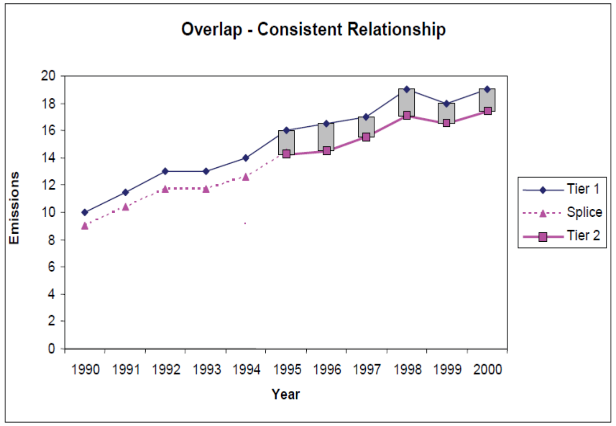
Overlap approach

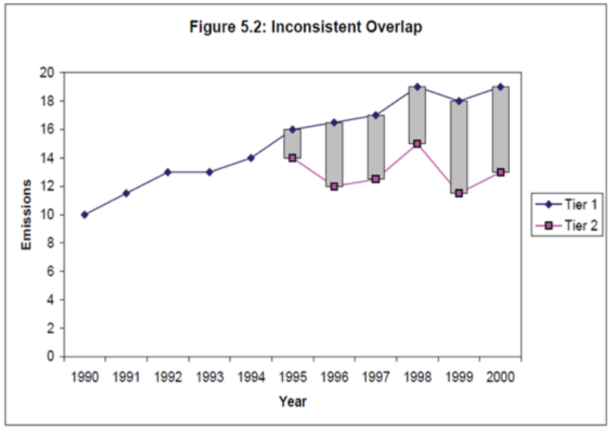
Assessment of comparability of two datasets over a time series

Looking for consistent overlap or difference

Preferably for multiple years to avoid bias

Can either use comparable dataset or recalculate existing data on the basis of consistency





Source: 2006 IPCCC Guidelines for National Greenhouse Gas Inventories: Chapter 5 – Time Series Consistency

Overlap approach

Step 1: Record data

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Industry A	5000	4900	4800	5000	4900	4800	4200	4100	4000	4000
Industry B	4790	4513	4320	4500	4410	4598	4035	?	?	?

Overlap approach

Step 2: Calculate ratios between datasets (= Industry A / Industry B)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Industry A	5000	4900	4800	5000	4900	4800	4200	4100	4000	4000
Industry B	4790	4513	4320	4500	4410	4598	4035	?	?	?

Ratio	0.96	0.92	0.90	0.90	0.90	0.96	0.96			

Overlap approach

Step 3: Determine average ratio

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Industry A	5000	4900	4800	5000	4900	4800	4200	4100	4000	4000
Industry B	4790	4513	4320	4500	4410	4598	4035	?	?	?

Ratio	0.96	0.92	0.90	0.90	0.90	0.96	0.96	0.93	0.93	0.93

(0.96+0.92+0.90+0.90+0.96+0.96) / 7 = 0.93

Overlap approach

Step 4: Use average ratio to estimate missing data

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Industry A	5000	4900	4800	5000	4900	4800	4200	4100	4000	4000
Industry B	4790	4513	4320	4500	4410	4598	4035	3806	3712	3713

Ratio	0.96	0.92	0.90	0.90	0.90	0.96	0.96	0.93	0.93	0.93

Data-filling techniques

Approach	
Proxy data (Scaling factor)	✓
Overlap	✓
Interpolation	▶
Extrapolation	

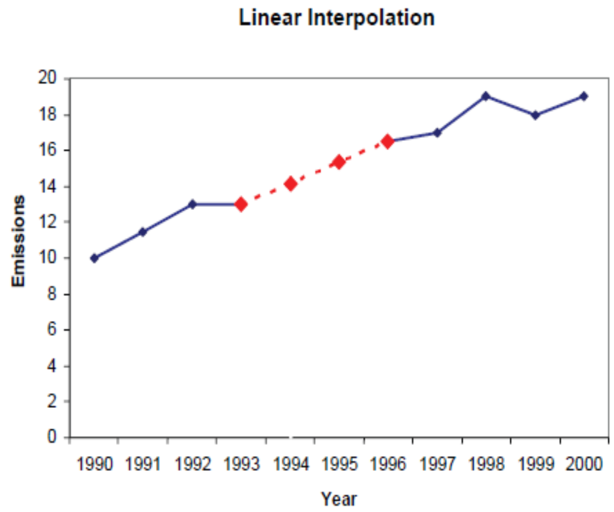
Interpolation approach

Interpolation makes use of trends in existing data to fill gaps during a time series between two or more data points e.g. periodic survey data

Simplest form of interpolation is linear by drawing a line between the edges of the gap

There are more sophisticated methods for interpolation that can accommodate more subtle features in trend

To increase confidence, compare interpolated data with proxy data



Source: 2006 IPCCC Guidelines for National Greenhouse Gas Inventories: Chapter 5 – Time Series Consistency

Interpolation approach

Step 1: Record and map data to determine if interpolation is suitable

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Waste sent to landfill (tonnes)	4,030	4,135	4,235	?	?	?	4,655	4,770	4,880	4,975

Interpolation approach

Step 2: Calculate difference between edges of gap

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Waste sent to landfill (tonnes)	4,030	4,135	4,235	?	?	?	4,655	4,770	4,880	4,975

Difference between edges of gap	4,655 – 4,235 = 420

Interpolation approach

Step 3: Calculate length of gap

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Waste sent to landfill (tonnes)	4,030	4,135	4,235	?	?	?	4,655	4,770	4,880	4,975

Difference between edges of gap	4,655 – 4,235 = 420
Length of gap	2007 – 2003 = 4 years

Interpolation approach

Step 4: Calculate average change per year

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Waste sent to landfill (tonnes)	4,030	4,135	4,235	?	?	?	4,655	4,770	4,880	4,975

Difference between edges of gap	4,655 – 4,235 = 420
Length of gap	2007 – 2003 = 4 years
Average change per year	420 / 4 = 105

Interpolation approach

Step 5: Fill gap year(s) by adding the average change per year

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Waste sent to landfill (tonnes)	4,030	4,135	4,235	4,340	4,445	4,550	4,655	4,770	4,880	4,975

Difference between edges of gap	4,655 – 4,235 = 420		
Length of gap	2010 – 2014 = 4 years		
Average change per year	420 / 4 = 105		
Fill gap	4235 +105	4340 +105	4445 +105

Data-filling techniques

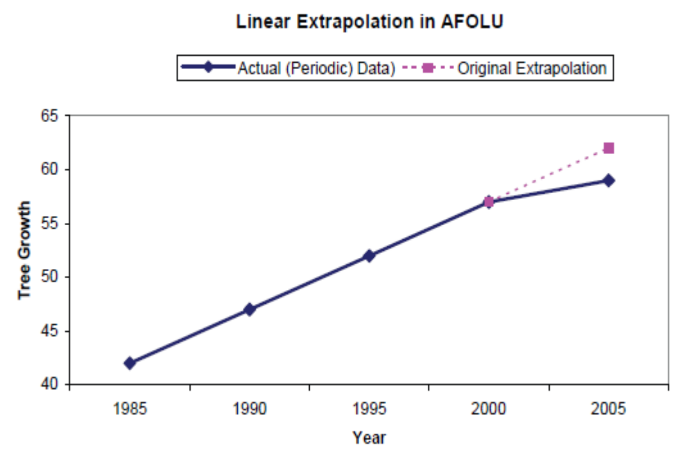
Approach	
Proxy data (Scaling factor)	✓
Overlap	✓
Interpolation	✓
Extrapolation	▶

Extrapolation approach

Extrapolation makes use of trends in existing data to extend a time series backwards or forwards

Ideally isn't used for an extended period of time (the longer the period, the greater the uncertainty), although an uncertain estimate is better than no estimate

Simplest form of extrapolation is linear; the gap at the end of a time-series is filled by extending the line of best fit from the end of the known time-series



Source: 2006 IPCCC Guidelines for National Greenhouse Gas Inventories: Chapter 5 – Time Series Consistency

Extrapolation approach

Step 1: Record and map data to determine if extrapolation is suitable

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Number of electric rickshaws	?	?	350	400	450	550	650	750	?	?

Extrapolation approach

Step 2: Establish trends

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Number of electric rickshaws	?	?	350	400	450	550	650	750	?	?
Establish trends			-50	-50	-50	+100	+100	+100		

Extrapolation approach

Step 3: Apply trends

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Number of electric rickshaws	250	300	350	400	450	550	650	750	850	950
Establish trends			-50	-50	-50	+100	+100	+100		
Apply trends	-50	-50							+100	+100

Module B

Calculating GHG emissions

04

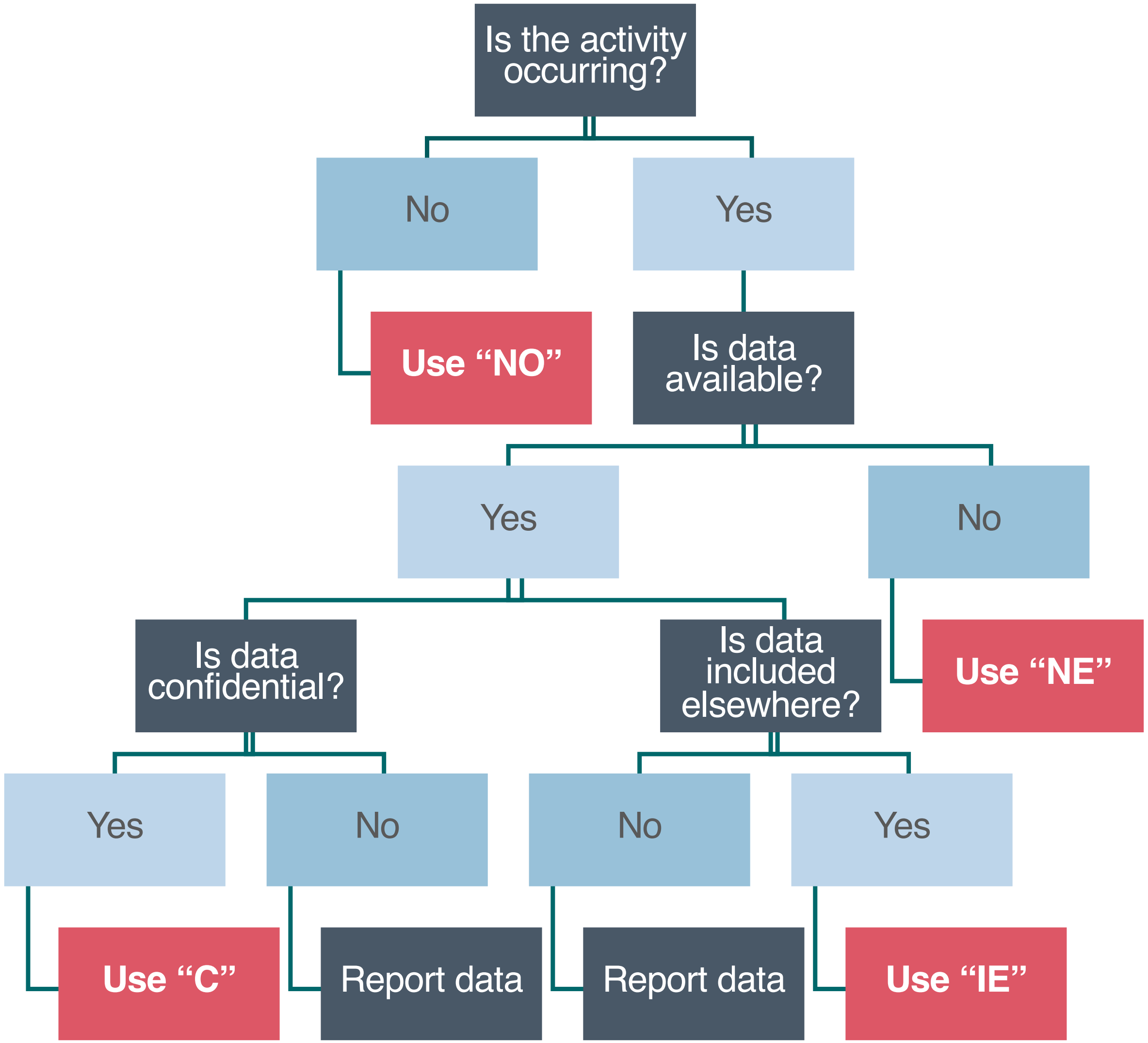
Notating keys

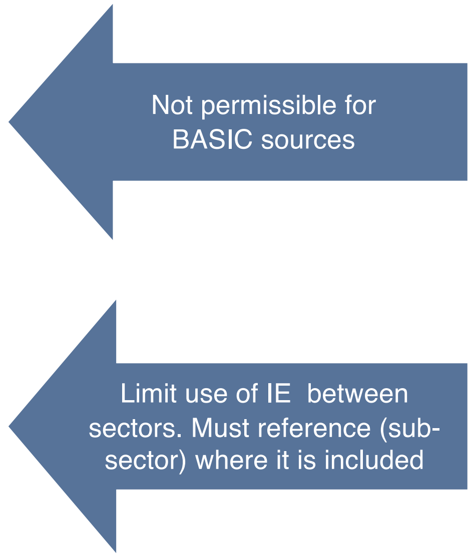
Notation keys

Notation key		Description	Example
NO	Not occurring	An activity or process does not occur or exist within the city	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 sales)
IE	Included elsewhere	Emissions are estimated and presented in another category	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.
NE	Not estimated	Emissions occur but have not been estimated or reported	III.4.3 has not been estimated. Activity not required for BASIC inventory. V.1 has not been estimated. No livestock data available
C	Confidential	Emissions occur but data cannot be disclosed; information is confidential	Activity data for IV.1 is confidential. Data cannot be aggregated to provide confidentiality II.5.1 is confidential. Military base within city boundary

Notation keys

All use of notation keys **must** be explained and/or justified





Insignificant sources

The notation key “NO” (not occurring) may also be used for **insignificant** sources:

- An emission source can be considered insignificant if the size of emissions is smaller than any other subsector that shall be reported.
- In addition, the combined emissions from all sources that are considered insignificant should not exceed 5% of total emissions that shall be reported.
- For example, if all the emissions sources that shall be reported amount to one million tonnes of CO2e, the total emissions of all insignificant sources cannot exceed 5% of that, i.e. 50,000 tonnes of CO2e. Local governments need to make a crude estimate of such emissions in order to determine if it is insignificant.

Exercise: Notation keys

Activity		Notation key
III.1	None of the city's waste is sent to landfill	NO – not occurring
II.2.2	The number of electric vehicles is very low	NO – not occurring
V.1	Emissions from land are too difficult to calculate	NE – not estimated
I.8	Fugitive emissions are too difficult to calculate	-
I.2.2	Electricity use in commercial buildings cannot be disaggregated from data for residential buildings	IE – Included elsewhere
II.4.1	The only airport in the city is a military airport. They do not allow their activity data to be disclosed.	C - Confidential
II.5.1	Off-road transportation is included in on-road data	IE – Included elsewhere

Module B

Calculating GHG emissions

05

Managing data quality

Evaluating data quality

When assessing data quality, of activity data and emission factors, it is important to consider the extent to which the data reflects:

- The geographic location of the activity
- Time or age of the activity
- Technologies used
- Assessment boundary and emission source
- Reliability of data source

Rating	Activity data	Emission factor
High	Detailed activity data	Specific emission factors
Medium	Modeled activity data using robust assumptions	More general emission factors
Low	Highly-modeled or uncertain activity data	Default emission factors

Exercise: Data quality assessments

Emissions source	Data quality
National average fuel use per household	Low
Quantity of solid waste weighed at a transfer station	High
CH_4 recovered from landfill based on system design	Medium
National average solid waste generated per person	Low
National statistics agency data on power generation	High
Number of buses based on published travel schedule	Medium
Number of buses based on traffic count over 2 days	Low
Metered office energy use, disaggregated by tariff	High

Module B

Calculating GHG emissions

06

Reviewing an inventory

Becoming a reviewer

Workbook

GTALCC GHG Accounting - Participant handbook

Exercises	
Module B	Calculating GHG emissions
	Reviewing an inventory
Module C	Stationary energy
Module D	Transportation
Module E	Waste
Module F	IPPU and AFOLU

Tables	
Table 1	GHG emission sources
Table 2	Fuel types
Table 3	GPC
Table 4	Action plan

Reference
GPC
GWP
Notation keys
Checklist

Workbook

Reviewing an inventory

1. Review the inventory below (boundary information and GHG emissions) and identify the ten mistakes

City information

Boundary	Information
Name of city	Pangea
Country	Tethys
Inventory year (if not calendar year, please specify the full 12-month period, e.g. 01 April 2014 - 31 March 2015)	01 January 2014 - 31 October 2014
Geographic boundary (select from list of values)	Administrative boundary of a local government
Land area (km2) within city boundary	2.455
Resident population within city boundary	3.837.414
GDP (US$) of economic activity within city boundary	17.454.000.000

Inventory information

Boundary	Information
GPC reporting level	BASIC
Greenhouse gases included in inventory	CO2, N2O
Global Warming Potential (select IPCC Assessment Report)	IPCC Second Assessment Report (1995) and IPCC Fourth Assessment Report (2007)

Exercise: Reviewing an inventory

City A has submitted a BASIC inventory. You have been asked to review the inventory to make sure that it is aligned with the requirements of the GPC.

In groups, review the inventory report for City A. It contains ten (10) mistakes. You have 25 minutes to identify them all, paying careful attention to the following:

- Is all the required information reported?
- Has the inventory boundary been properly defined?
- Are all BASIC sources included?
- Have notation keys been used correctly?
- Does the information look accurate?

Answers: Reviewing and inventory

		Error
1	Inventory boundary	Inventory year does not cover 12 months
2	Inventory boundary	No CH_4 included
3	Inventory boundary	Two IPCC assessment reports selected
4	Stationary: 1.8	Notation key NE used for a BASIC source
5	Stationary: 1.3	Scope 2 emissions too large
6	Transportation: II.5	Scope 1 emissions left blank
7	Transportation: II.2	Notation key IE used for Scope 2 without reference
8	Waste: III.4	Notation key NO used for Scope 1 & 3 emissions
9	BASIC total: II.4	BASIC total for aviation includes BASIC+ emissions
10	BASIC total: overall	Territorial emissions included in BASIC total

03
SUMMARY

Module B: Calculating GHG emissions

Module B: Calculating GHG emissions

01 Calculating GHG emissions

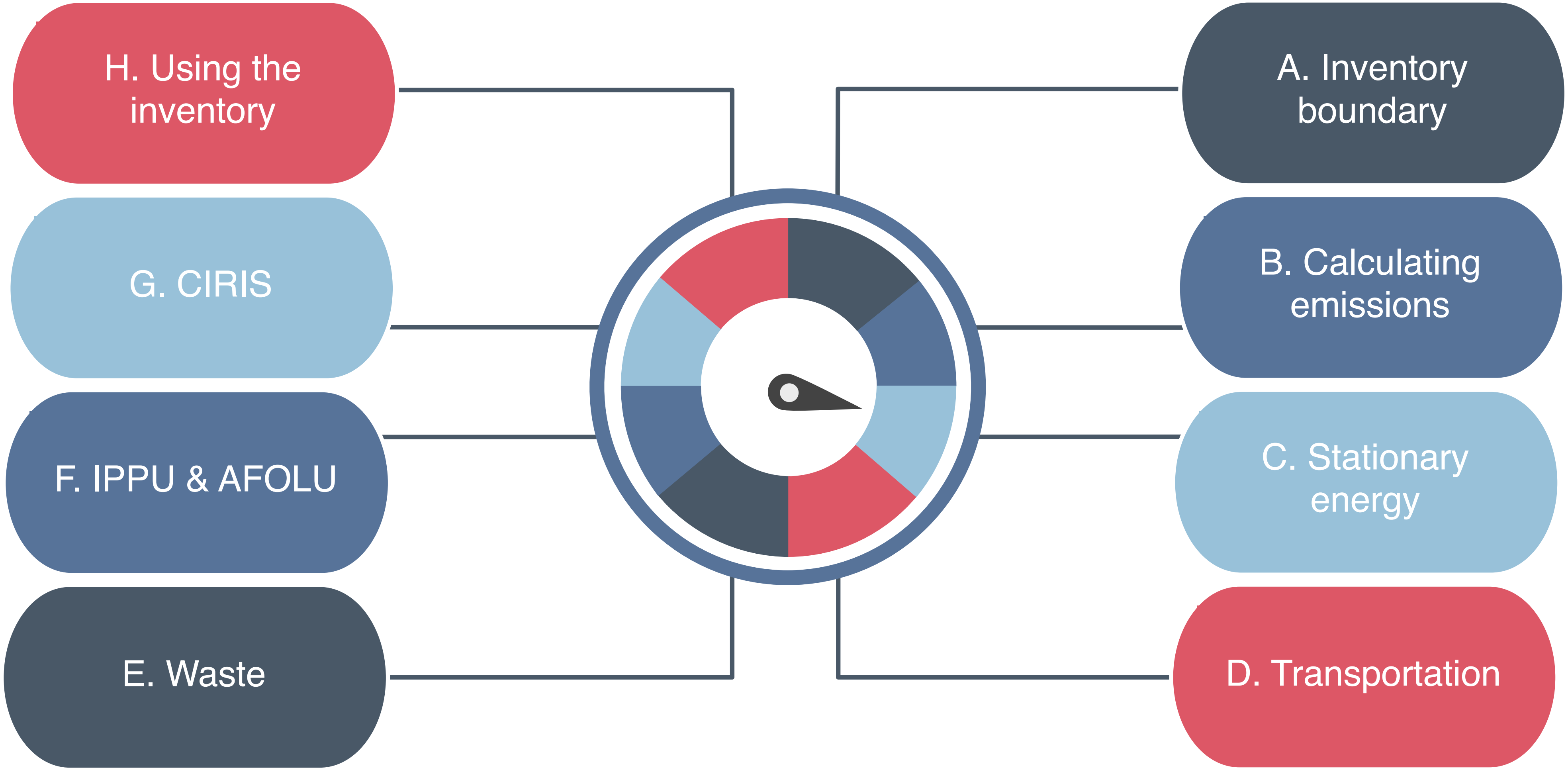
02 Sourcing data

03 Dealing with data challenges

04 Notation keys

05 Managing data quality

06 Reviewing an inventory


H. Using the inventory
G. CIRIS
F. IPPU & AFOLU
E. Waste
A. Inventory boundary
B. Calculating emissions
C. Stationary energy
D. Transportation

The end

Next time: Stationary energy