United Nations Statistics Division

Energy indicators and emissions from energy

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http://unstats.un.org/unsd/greeneconomy

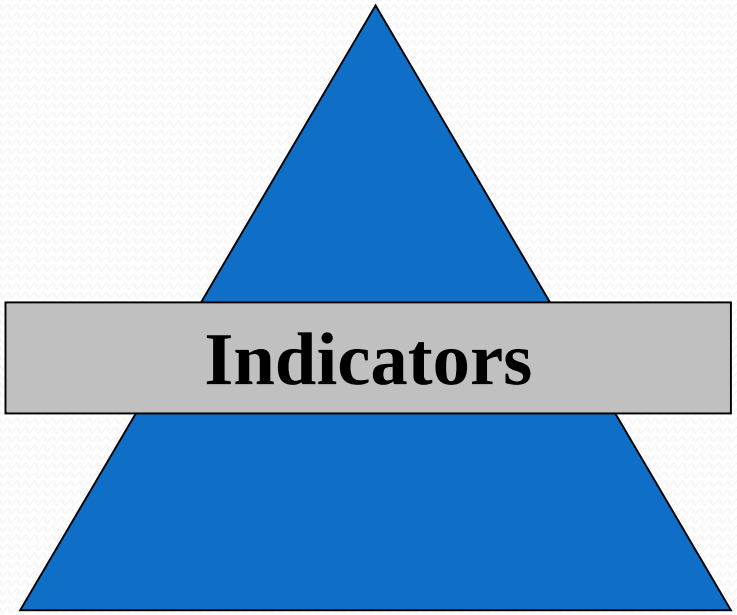
Outline

- Indicators
- SDG indicators
- Renewable energy indicators
- Efficiency indicators
- Calculation of CO_2 emissions
  - Introduction and motivation
  - IPCC methodology:
- Discussion

Indicators

Analyses / Policies

Are bases for analyses and policies formulation and monitoring



Can be incorporated on models or help checking and validating results

Statistics

Are derived from statistics

Models

SDG indicators: **motivation**

- Energy: a major enabler of sustainable development & indispensable for eradicating poverty
- Energy allows countries to accelerate economic development, to increase prosperity and to empower people and businesses
- Energy enables other universal goals including food security, good health, gender equality, water availability, economic growth, proper education, etc.
- Energy is key factor for tackling climate change
- 1.2 billion people without electricity and 2.8 billion still depending on unsustainable solid biomass
- 4 million premature deaths annually are due to indoor pollution from lack of access to clean energy fuels

Goals *vs.* Targets *vs.* Indicators

- Goals: if something is important enough to our shared vision of the world in 2030, it should be the subject of a goal
- Targets: instrumental to achieving our goals – Goals densely linked to multiple other goals through targets
  - E.g. share of renewables (climate change, sustainable production, sustainable energy, etc)
  - Cross-cutting the agenda
  - High leverage, impact
- Indicators: measurable proxies for our targets

Goal 7

- Ensure access to affordable, reliable, sustainable and modern energy for all
- Target 7.1 By 2030, ensure universal access to affordable, reliable and modern energy services
- Target 7.2 By 2030, increase substantially the share of renewable energy in the global energy mix
- Target 7.3 By 2030, double the global rate of improvement in energy efficiency
- Target 7.a By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology
- Target 7.b By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States and landlocked developing countries, in accordance with their respective programmes of support

Energy Targets and Corresponding Indicators

7.1 Energy Access

Indicator 7.1.1 Percentage of population with electricity access, %

Indicator 7.1.2 Percentage of population with primary reliance on clean fuels and technologies, %

7.2 Renewable Energy

Indicator 7.2.1 Renewable energy share in the total final energy consumption (or total primary energy), %

7.3 Energy Efficiency

Indicator 7.3.1 Rate of improvement in energy intensity (%) measured in terms of primary energy and GDP

7.a International Cooperation and Investment

Indicator 7.a.1 Mobilized amount of USD per year starting in 2020 accountable towards the USD 100 billion commitment

7.B Expand infrastructure and upgrade technology

Indicator 7.b.1

Data collection issues and practices
TES vs. Final energy consumption

- While TES represents energy entering the national territory for the first time in a form suitable for use (primary energy),
- Final energy consumption (FEC) represents a measure of energy as it is finally consumed*(closer to a measure of useful energy)
- The difference between TES and FEC consists of:
  - Transformation losses
  - Energy industries own use (amount of energy consumed in the production of energy products)
  - Losses (e.g., transmission and distribution losses)
  - Non-energy use of fossil fuels and their derived products

* Strictly speaking, energy cannot be consumed. Here, Energy consumption means the consumption of energy products listed in SIEC

	Example country										
	Terajoules										
2016	Primary coal and peat	Coal and peat products	Primary oil	Oil products	Natural gas	Biofuels and waste	Nuclear	Electricity	Heat	Total energy	of which: renewable
Primary production	3400		1234		345	4567	67	234	34	9881	4835
Imports	748	158	420	1024	180	10		81		2621	10
Exports	-319	-265	-101	-873	-40	-6		-12		-1616	-6
Int'l mar. bunkers				-28						-28	
Int'l av. bunkers				-78						-78	
Stock changes	-14		170	-81						75	
TES	3815	-107	1723	-36	485	4571	67	303	34	10855	4839
Stat. difference	19	32	3	-26	-10	0	0	0	0	18	
Transfers											
Transformation	-2201	270	-1680	1640	-300	-780	-67	870	587	-1661	-124
Energy ind own use	-87	-31	-30		-43			-89	-124	-404	X
Losses	0		-10					-165	-88	-263	X
Final Consumption	1508	100	0	1630	152	3791	0	919	409	8509	4059
FEC	1500	86	0	1544	139	3791	0	919	409	8388	???
Manufacturing	1500	86	0	255	48	650	0	370	409	3318	
Transport	0	0	0	1152	4	0	0	56	0	1212	
Other	0	0	0	137	87	3141	0	493	0	3858	
Non-energy use	8	14	0	86	13	0	0	0	0	121	

Advantages of using TES

- TES – with few exceptions, it is already hard to tell whether imported/exported electricity is renewable or not
- FEC – add to that:
  - transformation losses of mixed biomass/fossil fuels
  - electricity and heat own use and losses
- Data on supply more readily available than on consumption, particularly for developing countries
- FEC subject to more uncertainties due to estimation

Advantages of using FEC

- We compare electricity with electricity, and not with the primary energy source (e.g. nuclear heat vs hydro electricity)
- Non-energy use of fossil fuels is not taken into account (it is included in TES)
  - Since these fuels are not burned and are accounted for in the item “non-energy use”

Renewable energy supply
[% total energy supply ,TES]

- The share of renewables in the TES is defined as a ratio between the renewable energy supply and the TES
- TES represents energy entering the national territory for the first time, less energy exiting from the national territory (through exports or international bunkering) and stock changes. Thus,

- Total energy supply =
  + Primary energy production
  + Import of primary and secondary energy
  - Export of primary and secondary energy
  - International (aviation and marine) bunkers
  - Stock Changes

Renewable energy supply (% of TES) from energy balance – top block

country

Terajoules

	Primary coal and peat	Coal and peat products	Primary oil	Oil products	Natural gas	Biofuels and waste	Nuclear	Electricity	Heat	Total energy	*of which: renewable*
2016											
Primary prod.	3400		1234		345	4567	67	234	34	9881	4835
Imports	748	158	420	1024	180	10		81		2621	10
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Int'l mar. bunkers				-28						-28	
Int'l av. bunkers				-78						-78	
Stock changes	-14		170	-81						75	
TES	**3815**	**-107**	**1723**	**-36**	**485**	**4571**	**67**	**303**	**34**	**10855**	**4839**

In this case, the indicator would be 4839/10855 = 44.6%

Renewable energy supply (% of TES)
Importance on specific NCVs

2016	Primary coal	Biofuels and waste	Total energy	*of which: renewable*	default Coal NCVs	default fuelwood NCVs
Primary production	3400	4567	9881	4835	**25.80**	**9.135**
Imports	748	10	2621	10	**25.80**	**9.135**
Exports	-319	-6	-1616	-6	**25.80**	**9.135**
Stock changes	-14		75		**25.80**	
Total energy supply	**3815**	**4571**	**10855**	**4839**		

Indicator **44.6%**

2016	Primary coal	Biofuels and waste	Total energy	*of which: renewable*	Specific NCVs	default NCVs
Primary production	2649	4567	9130	4835	**20.10**	**9.135**
Imports	673	10	2546	10	**23.20**	**9.135**
Exports	-349	-6	-1646	-6	**28.20**	**9.135**
Stock changes	-11		78		**20.10**	
Total energy supply	**2962**	**4571**	**10002**	**4839**		

48.4%

2016	Primary coal	Biofuels and waste	Total energy	*of which: renewable*	Specific NCVs	Specific NCVs
Primary production	2649	5749	10312	6017	**20.10**	**11.50**
Imports	673	13	2548	13	**23.20**	**11.50**
Exports	-349	-8	-1647	-8	**28.20**	**11.50**
Stock changes	-11		78		**20.10**	
Total energy supply	**2962**	**5754**	**11185**	**6012**		

53.8%

Based on an a assumption that the energy balance in the previous page was based on applying default NCVs from physical quantities:

- 25.8 GJ/ton for coal (other bituminous coal)
- 9.135 GJ/m³ for fuelwood (making all biomass)

Renewable electricity
[% total electricity generation]

- This indicator refers to the percentage of electricity generation coming from renewable sources, irrespective of whether primary or secondary electricity.
- Renewable sources for electricity comprise of: hydro, wind, solar (photovoltaic and solar thermal), geothermal, wave, tide and other marine energy, as well as the combustion of biofuels and renewable waste.
  - Nuclear electricity is excluded, but there is a related indicator "non-carbon electricity" in which it would be included
- A properly designed energy balance can be used to derive this indicator

Renewable electricity generation
(% of total) from balance

	Primary coal and peat		Biofuels and waste	Nuclear	Electricity	Heat	Total energy	of which: renewables
2012								
Primary production	3400	…	4567	67	234	34	9881	4835
Imports	748	…	10		81		2621	10
Exports	-319	…	-6		-12		-1616	-6
Int'l mar. bunkers		…					-28	
Int'l av. bunkers		…					-78	
Stock changes	-14	…					75	
TES	3815	…	4571	67	303	34	10855	4839
Stat. difference	19	…	0	0	0	0	18	
Transfers		…						
Transformation	-2201	…	-780	-67	870	587	-1661	-124
Electr. plants	-1601	…		67	701		-1267	
CHP plants	-300	…	-780		169	587	-324	-124

Not always possible to derive. In this case, for CHP plants the electricity and heat from combusted biomass needs to be disentangled from the electricity from coal.
However, electricity stats are usually detailed enough to provide such information.

Proportion of bioenergy in total renewable (primary) energy production

- Bioenergy is energy from biofuels, including different types wastes and byproducts, such as bagasse and black liquor
- Share of bioenergy on renewable energy prod. = (Biofuels prod/Total renewable production*100
  - Difference: primary electricity and primary heat (excluding nuclear heat)
- Only primary production should be considered to avoid double counting (as such, charcoal, for example, is excluded)
- Since only primary production is considered, this indicator can be easily derived from an energy balance

Proportion of bioenergy in total renewable energy production (from balances)

country

Terajoules

	Primary coal and peat	Coal and peat products	Primary oil	Oil products	Natural gas	Biofuels and waste	Nuclear	Electricity	Heat	Total energy	*of which: renewable*
2012											
Primary prod.	3400		1234		345	4567	67	234	34	9881	4835
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Stock changes	-14		170	-81						75	
TES	**3815**	**-107**	**1723**	**-36**	**485**	**4571**	**67**	**303**	**34**	**10855**	**4839**

In this case, the indicator would be 4567/4835 = 94.5%

Proportion of bioenergy in total renewable energy production (specific NCVs)

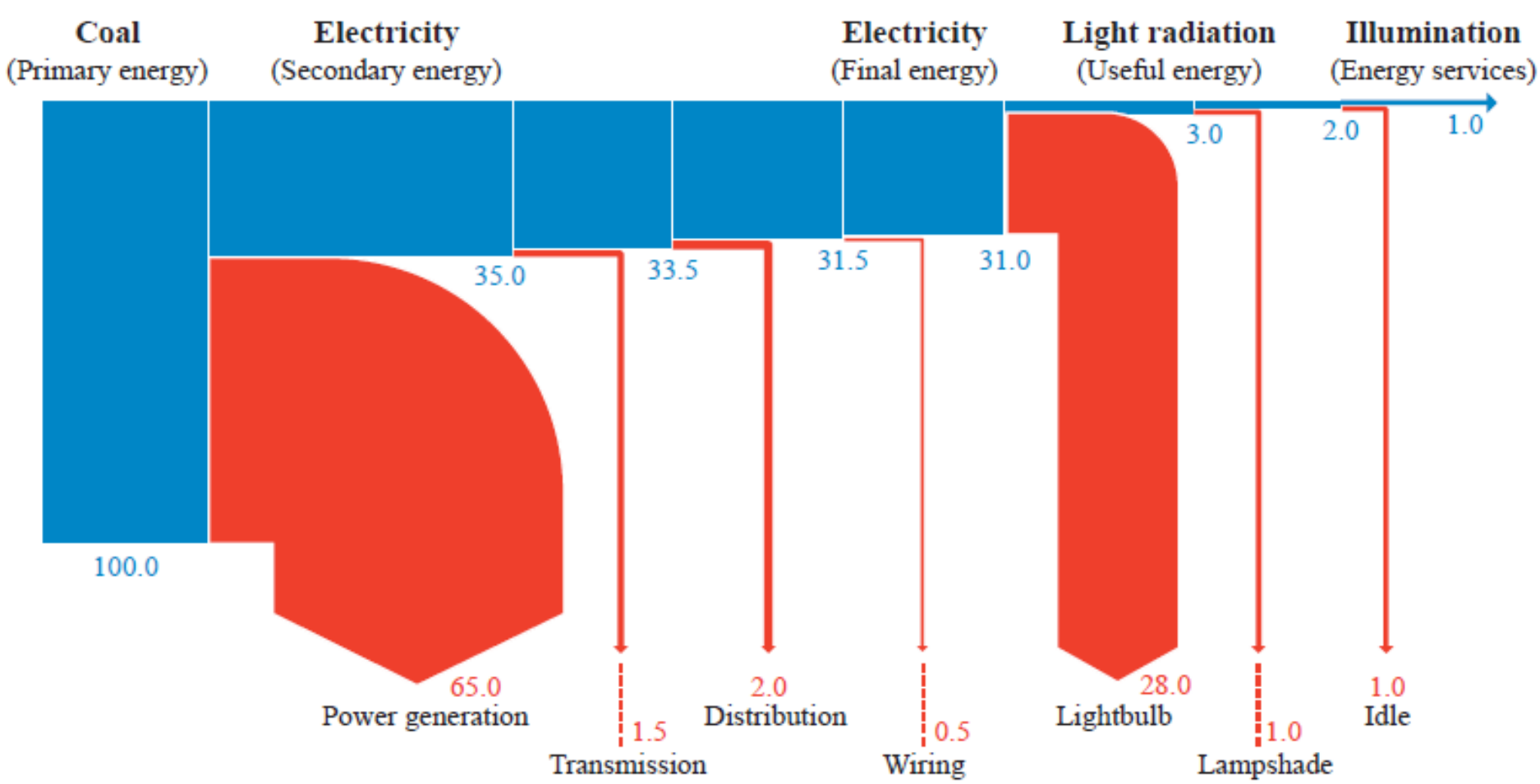
2012	Biofuels and waste	Total energy	*of which: renewable*	default fuelwood NCVs	Indicator
Primary production	4567	9881	4835	**9.135**	**94.5%**
Imports	10	2621	10	**9.135**	
Exports	-6	-1616	-6	**9.135**	
Stock changes		75			
Total energy supply	**4571**	**10855**	**4839**		

2012				Specific NCVs	
Primary production	5749	10312	6017	**11.50**	**95.5%**
Imports	13	2548	13	**11.50**	
Exports	-8	-1647	-8	**11.50**	
Stock changes		78			
Total energy supply	**5754**	**11185**	**6012**		

Based on an a assumption that the energy balance in the previous page was based on applying default NCVs from physical quantities:

- 9.135 GJ/m^3 for fuelwood (making all biomass)
- In this case, not a big difference because the indicator was already close to 100%

Energy efficiency from generation to end-use



Efficiency of thermal power plants

Viet Nam - Viet Nam

Item	2007	2008	2009	2010	2011	2012
Combustible fuel input	**(Terajoules - Térajoules)**					
Hard Coal	187979	189298	192580	262596	318544	333345
Gas-diesel oil	8729	2537	946	10922	5375	5676
Fuel oil	25048	22503	25452	36804	39107	41168
Natural gas	228706	264840	300626	355008	320195	353235
Fuelwood	931	654	735	637	644	651
Total input	451393	479832	520339	665967	683866	734074
Total production	158303	170676	191498	240408	230198	236434
Estimated efficiency (% of production to input)	35	36	37	36	34	32

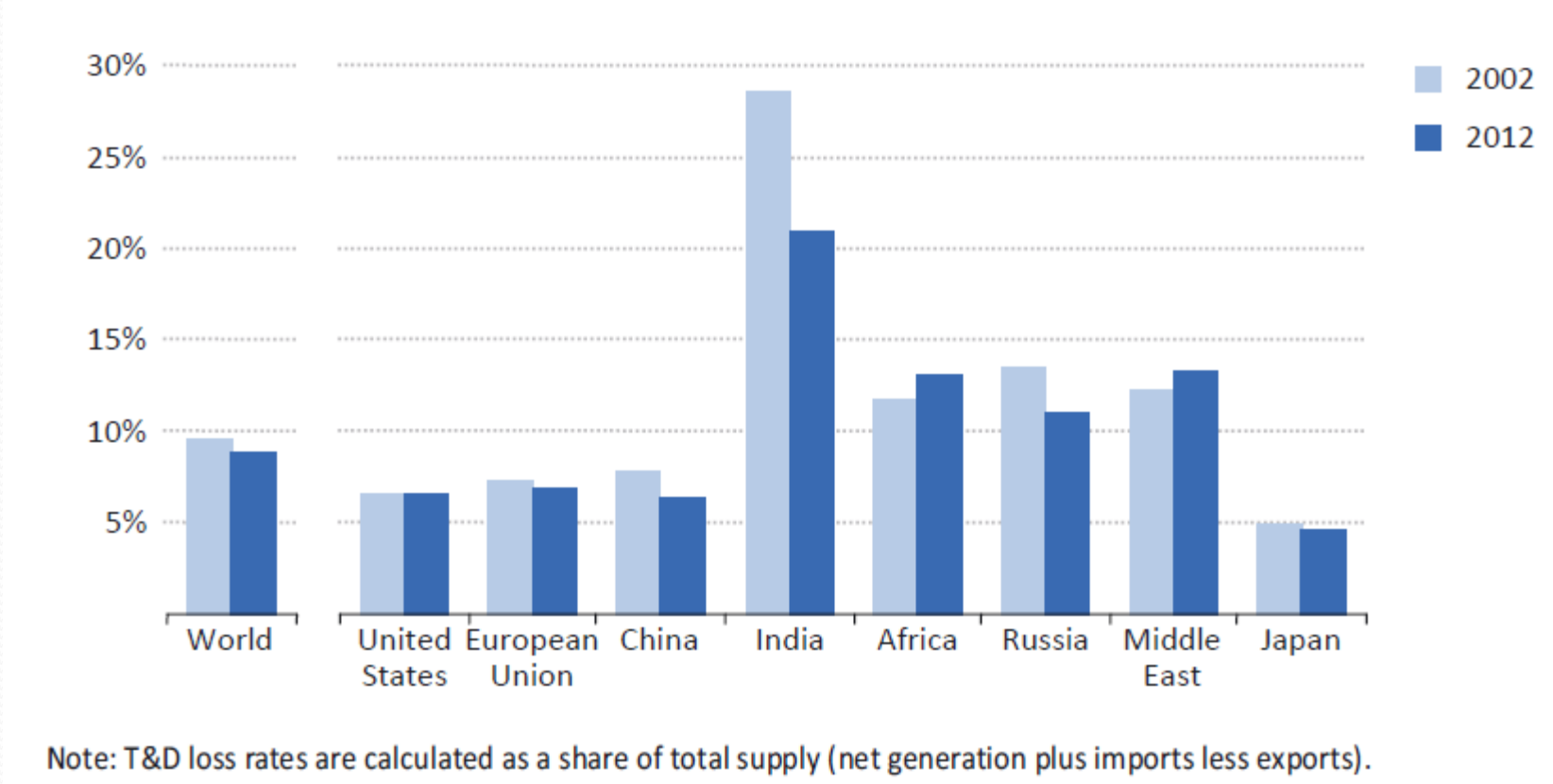
- Source: UNSD electricity profiles

Efficiency of the transformation sector

	Primary coal and peat	Coal and peat products	Primary oil	Oil products	Natural gas	Biofuels and waste	Nuclear	Electricity	Heat	Total energy	*of which: renewable*
2016											
Transformation	**-2201**	**270**	**-1680**	**1640**	**-300**	**-780**	**-67**	**870**	**587**	-1661	**-124**
Electricity plants	-1601				-300		-67	701		-1267	
CHP plants	-300					-780		169	587	-324	-124
Heat plants										0	
Coke ovens	-257	240								-17	
Briquetting plants	-43	40								-3	
Liquefaction plants										0	
Gas works										0	
Blast furnaces		-10								-10	
NGL plants and gas blending			-200	190						-10	
Oil refineries			-1480	1450						-30	
Other transformation										0	
Energy industries own use	-87	-31	-30		-43			-89	-124	-404	X

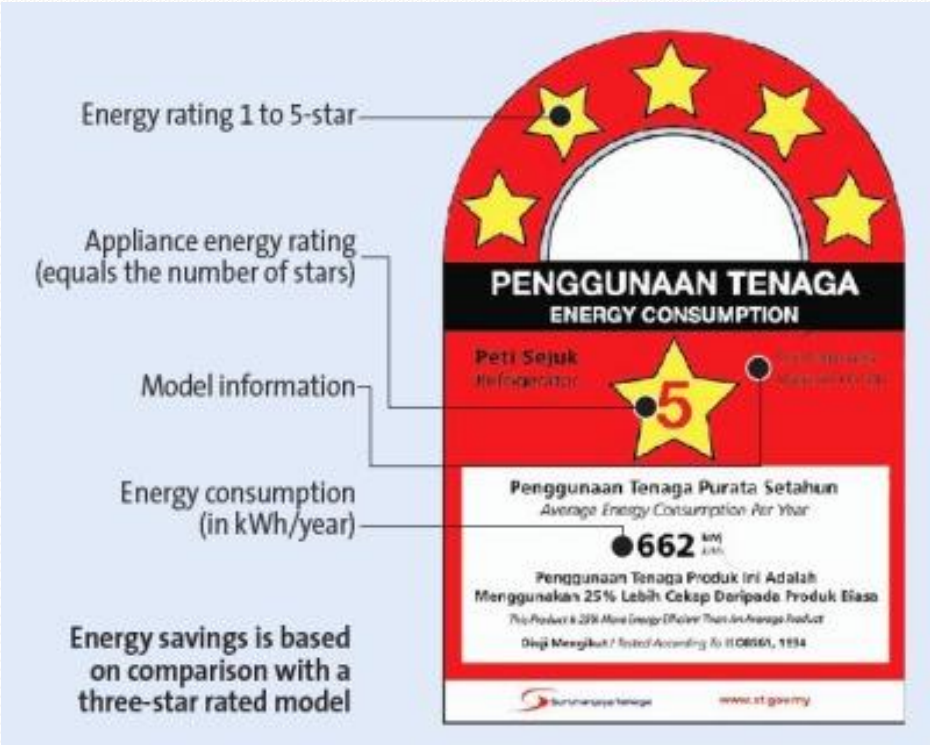
- Sector-wise, you can have an idea of the transformation efficiencies by type of transformation, by using an energy balance
- However, you need more detailed energy statistics to know it more precisely (and specific NCVs!)
- And maybe microdata to know individual plant efficiencies

Efficiency of transmission & distribution

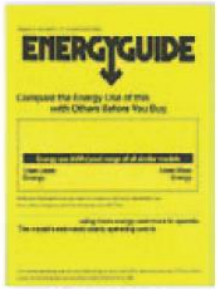


- Transmission and distribution losses (source: IEA)
- Country size, non-technical losses (theft) and maintenance influence these numbers

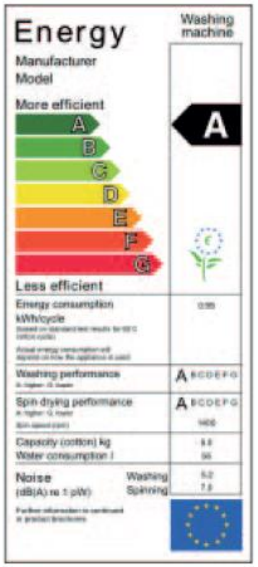
Efficiency of electrical appliances



Singapore

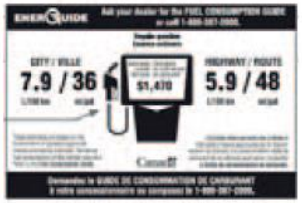


United States

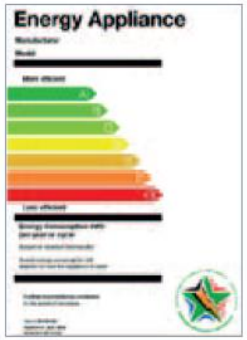


European Union

Viet Nam

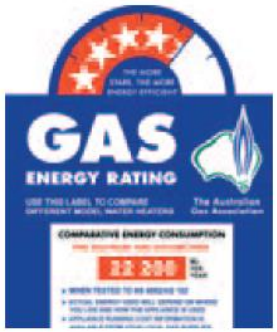


Canada



South Africa

Hongkong, China



Australia

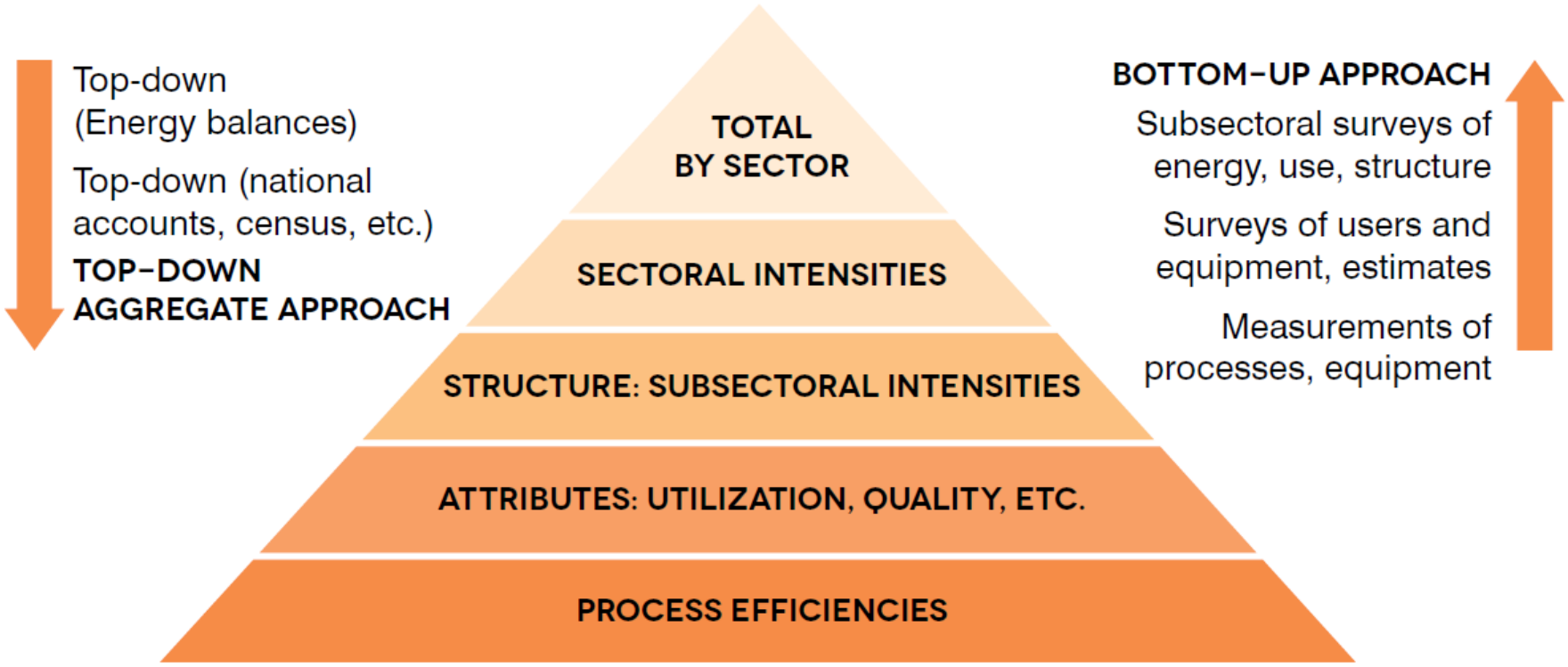
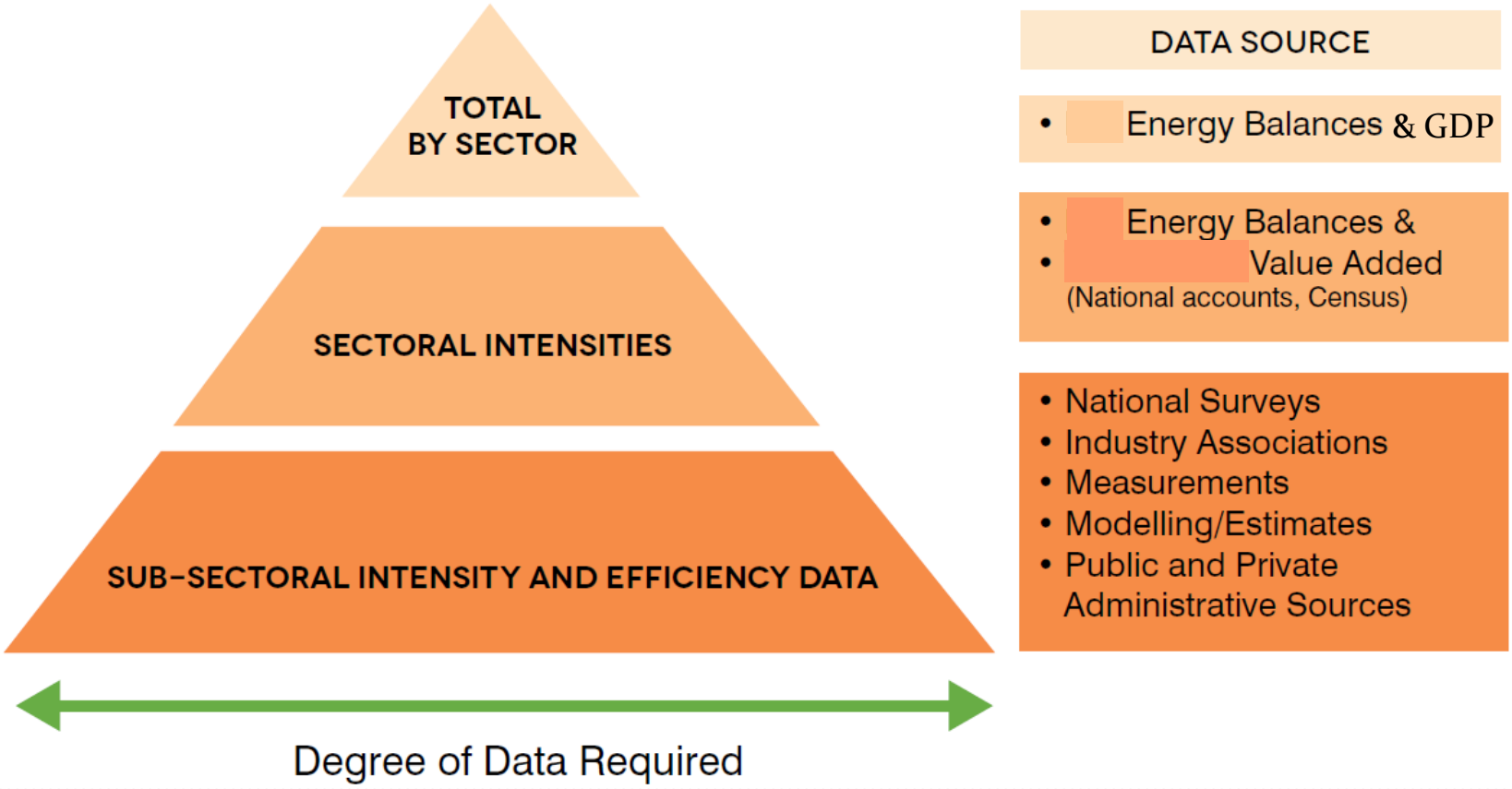


FIGURE 3.1 PYRAMID OF ENERGY EFFICIENCY INDICATORS

SOURCE: MARTIN AND OTHERS 1995; IEA 1997; PHYLIPSEN 2010.

Methodological issues
Monetary or physical output measures?



- Physical output measures make sense for subsectoral intensity and efficiency data
- Better to track efficiency changes in a country than to compare countries

Methodological issues
Monetary or physical output measures?

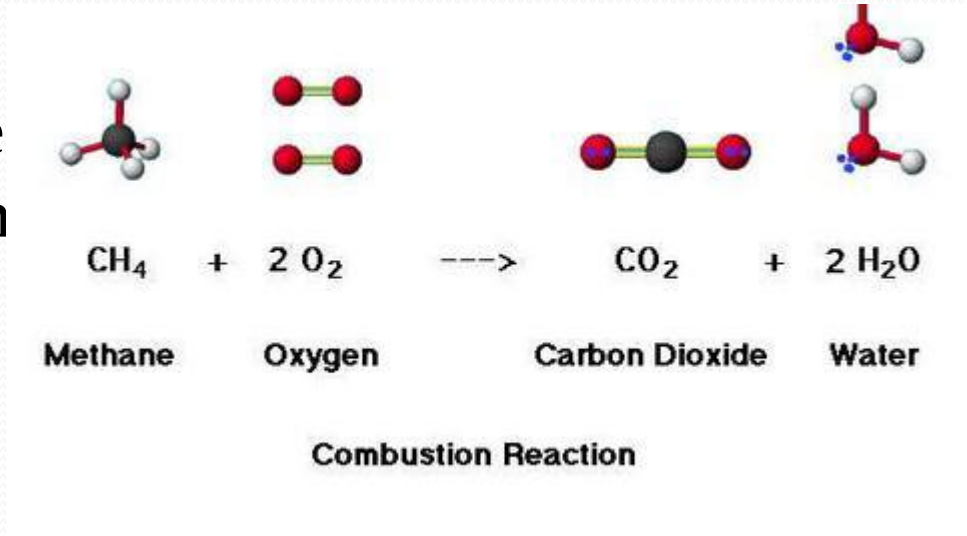
- For households, only physical measures are used:
  - Floor area, number of households, population
  - They relate to heating, cooking, cooling, lighting
  - Comparisons may be distorted by better access to affordable energy services (both b/w countries and in time)
- For services, both monetary and physical (usually floor area) measures can be used
  - Physical measures relate to heating, cooling, lighting
  - Specific subsectors may have more specific measures (such as bed capacity and # of occupied beds for hospitals)

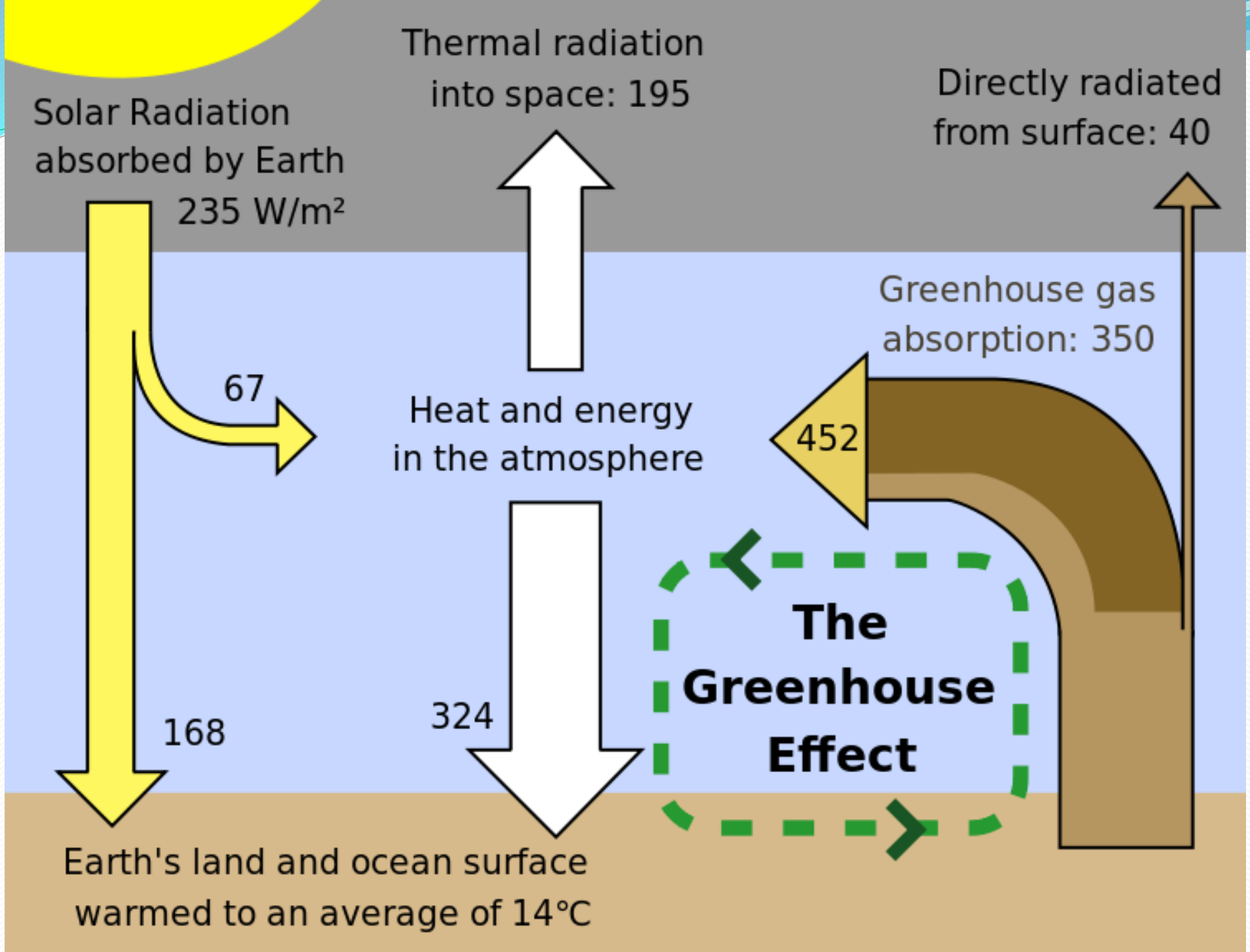
Methodological issues
Monetary or physical output measures?

- For transport, physical output measures can be passenger-kilometer, tons of freight-kilometer, vehicle-kilometer
  - Intensity per vkm relates to the specific vehicle efficiency
  - intensity per pkm (similarly for tkm) also depends on the "usage efficiency": using one vehicle to move three people is more efficient than using three vehicles
- For specific industries, the respective output in physical terms (e.g., tons of iron, tons of paper & pulp) can be used
  - But not for overall industry or aggregates of industries producing different physical outputs

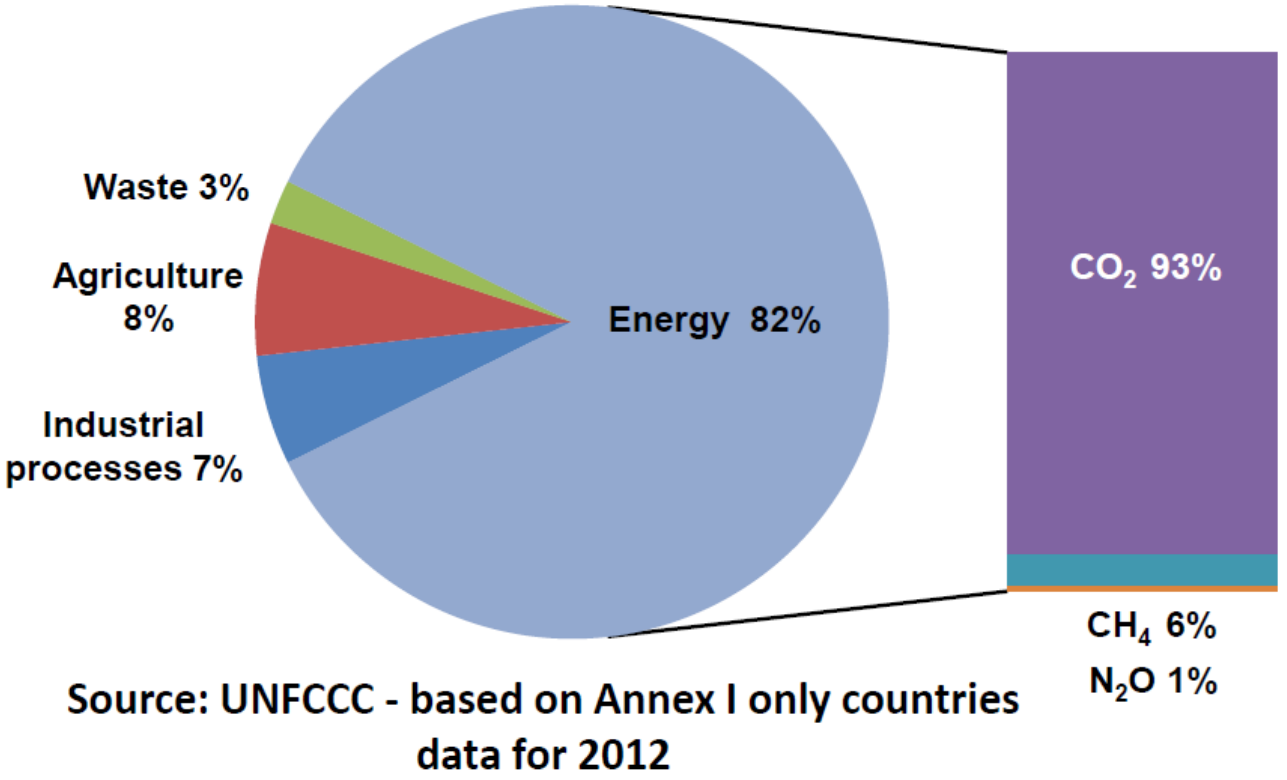
Calculation of emissions - Intro

- Energy system[illegible]nies largely driven by the combus[illegible]
- During combu[illegible] hydrogen of the fossil fuels are [illegible]o carbon dioxide (CO_2) and wat[illegible]he chemical energy in the fuel as h[illegible]
- This heat is [illegible] used (with some conve[illegible]ical energy, often to gen[illegible]tion.

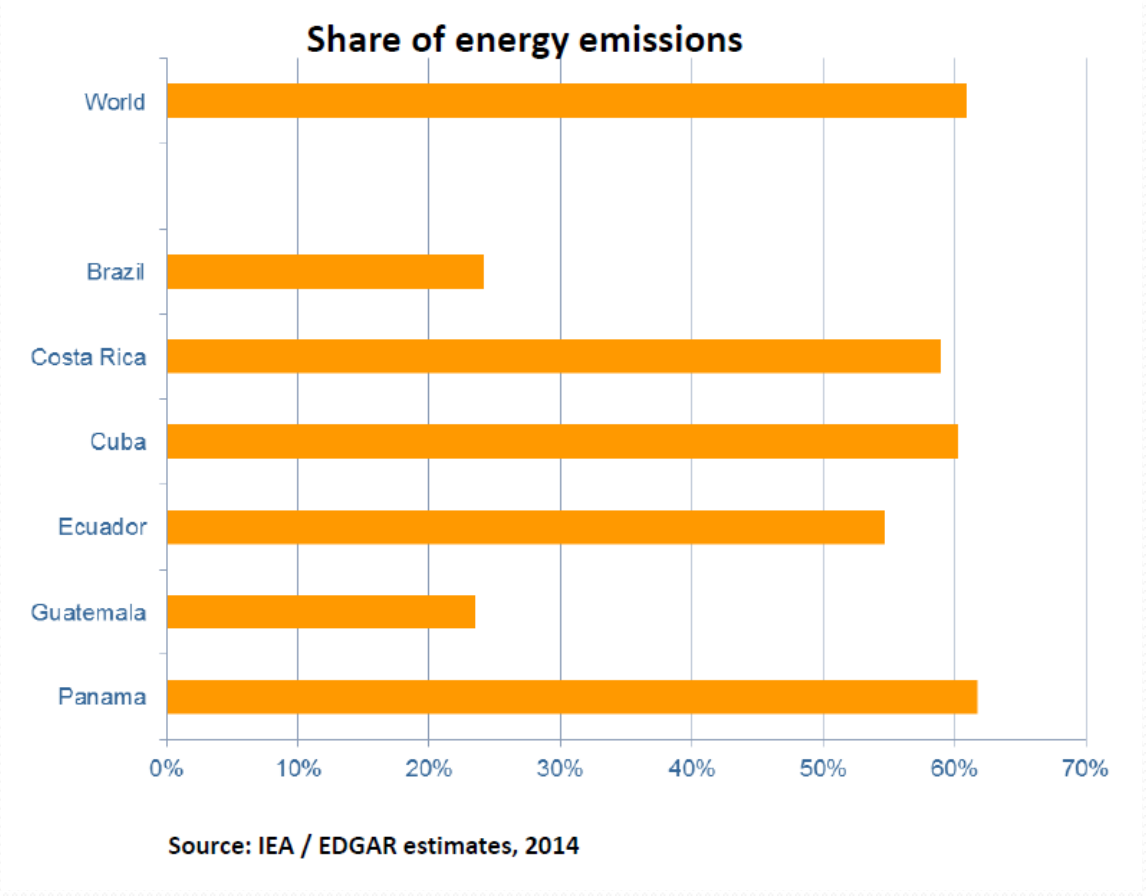



Thermal radiation
into space: 195
Solar Radiation
absorbed by Earth
235 W/m²
Directly radiated
from surface: 40
Greenhouse gas
absorption: 350
67
Heat and energy
in the atmosphere
452
The
Greenhouse
Effect
324
168
Earth's land and ocean surface
warmed to an average of 14°C

Energy as a main driver of GHG emissions and CO_2 share



Energy-related CO2 constitute the great majority of GHG emissions



- However, this share varies across countries
- Country circumstances should be taken into consideration (climate, reliance on energy-intense industries, etc)

IPCC

- The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change.
- It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988
  - to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts.
- In the same year, endorsed by the UN General Assembly.
- Currently 195 countries are members of the IPCC.

IPCC methodology for estimating CO2 emissions

- The energy sector mainly comprises:
  - exploration and exploitation of primary energy sources
  - conversion of primary energy sources into more useable energy forms in refineries and power plants
  - transmission and distribution of fuels
  - use of fuels in stationary and mobile applications
- Emissions arise from these activities by combustion and as fugitive emissions, or escape without combustion
- For inventory purposes, *fuel combustion* may be defined as *the intentional oxidation of materials within an apparatus that is designed to provide heat or mechanical work to a process, or for use away from the apparatus.**

* This allows a distinction of productive energy use from the heat released from the use of hydrocarbons in chemical reactions in industrial processes, or from the use of hydrocarbons as industrial products.

IPCC methodology for estimating CO2 emissions

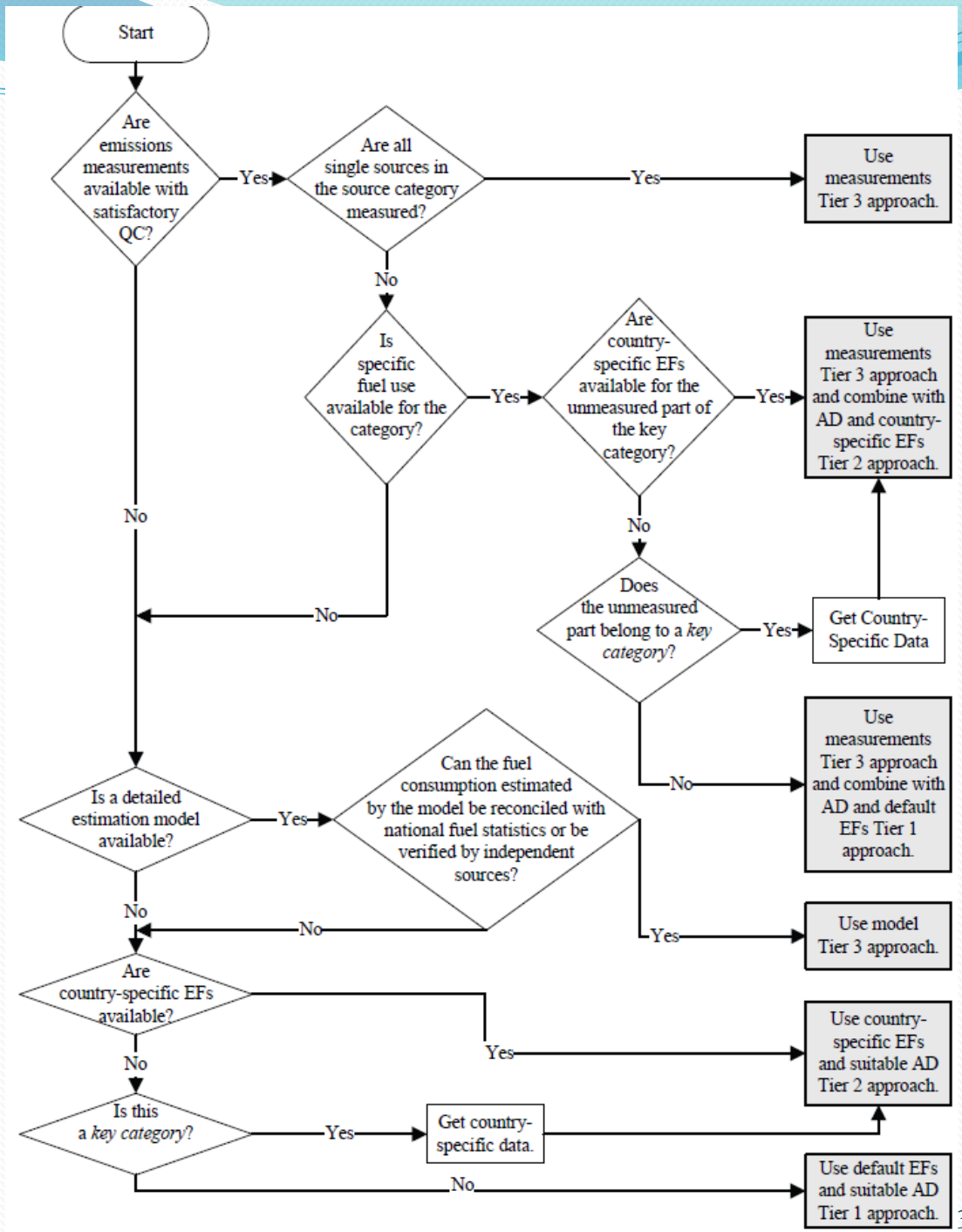
- Typically, only a few percent of the emissions in the energy sector arise as *fugitive emissions* from extraction, transformation and transportation of primary energy carriers.
- Examples are leakage of natural gas and the emissions of methane during coal mining and flaring during oil/gas extraction and refining.
  - These are not within the general scope of energy statistics, but can be collected as memo items

IPCC methodology - Tiers

- **TIER 1**
  - The method is fuel-based, since emissions from all sources of combustion can be estimated on the basis of the **quantities of fuel combusted** (usually from national energy statistics) and **average emission factors**.
  - Emission factors are available for all relevant direct greenhouse gases.
- **TIER 2**
  - Emissions from combustion are estimated from similar fuel statistics as in Tier 1, but **country-specific emission factors** are used instead of defaults
- **TIER 3**
  - Either **detailed emission models** or **measurements and data at individual plant level** are used where appropriate
  - Properly applied, Tier 3 should provide better estimates primarily for non-CO_2 GHGs, though at the cost of more detailed information and effort (for CO_2 only, usually not worthwhile)

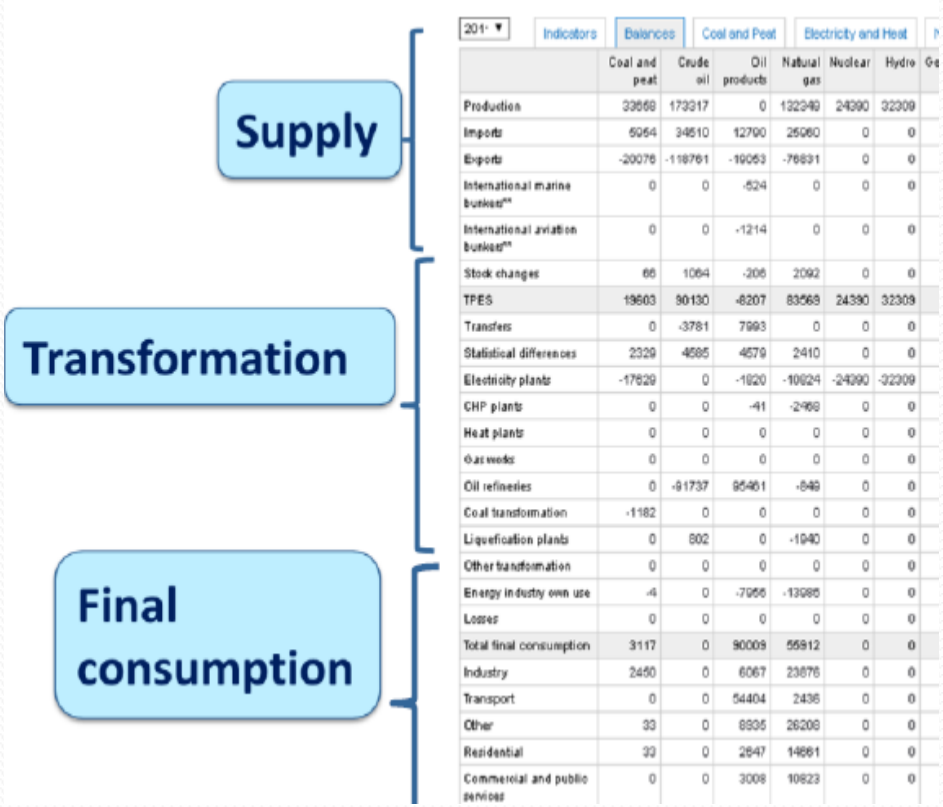
Decision tree for Tiers

- It's possible to mix tiers in the calculation of the national aggregate
- It's usually not worth the effort to use Tier 3 for CO_2 emissions only
- For the other two tiers, energy statistics are paramount
- The difference being the specificity of calorific values and emission factors



IPCC methodology
Data collection issues

- Harmonised energy product definitions are provided in IRES for all SIEC products
- Properly constructed energy balances allows for allocation of emissions to sectors
  - as well as to duly take exclusions into account (e.g., bunkers vs. domestic transport)

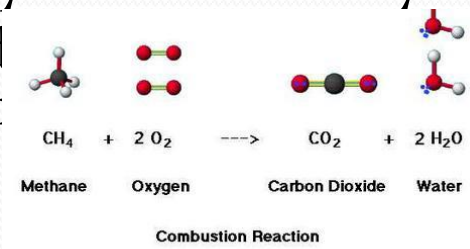


	Coal and peat	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Ge
Production	33668	173317	0	132349	24390	32309	
Imports	5954	34610	12790	25060	0	0	
Exports	-20076	-118761	-19053	-76831	0	0	
International marine bunkers**	0	0	-524	0	0	0	
International aviation bunkers**	0	0	-1214	0	0	0	
Stock changes	66	1064	-206	2092	0	0	
TPES	19603	90130	-8207	83569	24390	32309	
Transfers	0	-3781	7993	0	0	0	
Statistical differences	2329	4585	4579	2410	0	0	
Electricity plants	-17629	0	-1920	-10924	-24390	-32309	
CHP plants	0	0	-41	-2466	0	0	
Heat plants	0	0	0	0	0	0	
Gas works	0	0	0	0	0	0	
Oil refineries	0	-91737	95461	-849	0	0	
Coal transformation	-1182	0	0	0	0	0	
Liquefaction plants	0	802	0	-1940	0	0	
Other transformation	0	0	0	0	0	0	
Energy industry own use	-4	0	-7956	-13985	0	0	
Losses	0	0	0	0	0	0	
Total final consumption	3117	0	90009	55912	0	0	
Industry	2450	0	6067	23876	0	0	
Transport	0	0	54404	2436	0	0	
Other	33	0	8935	26208	0	0	
Residential	33	0	2647	14661	0	0	
Commercial and public services	0	0	3008	10823	0	0	

IPCC methodology

Conversion to energy units

- In energy statistics and other energy data compilations, production and consumption of solid, liquid and gaseous fuels are specified in physical units, e.g. in tonnes or cubic metres.
- To convert these data to common energy units, e.g. tonnes to terajoules, requires calorific values. That is done already in the construction of energy balances!
- The IPCC Guidelines use net calorific values (NCVs), expressed in SI units or multiples of SI units (for example TJ/Mg).
  - Some statistical offices use gross calorific values (GCV). The difference between NCV and GCV is the latent heat of vaporisation of the water produced during combustion of the fuel. If countries use GCV, they should identify them as such.
  - As a consequence, for coal and ut 5 percent less than the GCV For most fo manufactured gas, the NCV is about 10 perce



IPCC methodology
Conversion to energy units

TABLE 1.2
DEFAULT NET CALORIFIC VALUES (NCVS) AND LOWER AND UPPER LIMITS OF THE 95% CONFIDENCE INTERVALS [1]

Fuel type English description		Net calorific value (TJ/Gg)	Lower	Upper
Crude Oil		42.3	40.1	44.8
Orimulsion		27.5	27.5	28.3
Natural Gas Liquids		44.2	40.9	46.9
Gasoline	Motor Gasoline	44.3	42.5	44.8
	Aviation Gasoline	44.3	42.5	44.8
	Jet Gasoline	44.3	42.5	44.8
Jet Kerosene		44.1	42.0	45.0
Other Kerosene		43.8	42.4	45.2
Shale Oil		38.1	32.1	45.2
Gas/Diesel Oil		43.0	41.4	43.3
Residual Fuel Oil		40.4	39.8	41.7
Liquefied Petroleum Gases		47.3	44.8	52.2

- 2006 IPCC table (partial)
- Same as IRES default values, which are used to construct balances **in the absence of specific values**

IPCC methodology

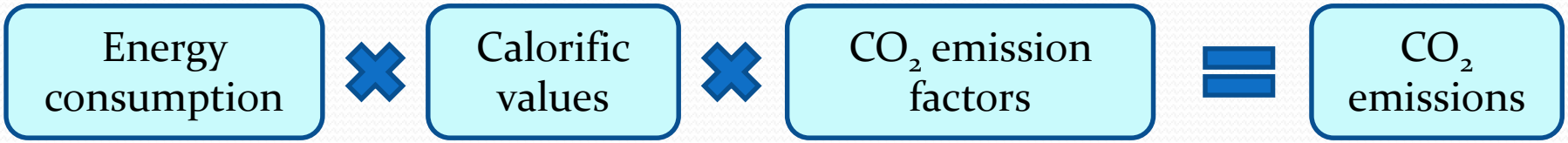
Default CO_2 Emission Factors

TABLE 1.4
DEFAULT CO_2 EMISSION FACTORS FOR COMBUSTION [1]

Fuel type English description		Default carbon content (kg/GJ)	Default carbon oxidation factor	Effective CO_2 emission factor (kg/TJ) [2]		
				Default value [3]	95% confidence interval	
		A	B	C=A*B*44/12*1000	Lower	Upper
Crude Oil		20.0	1	73 300	71 100	75 500
Orimulsion		21.0	1	77 000	69 300	85 400
Natural Gas Liquids		17.5	1	64 200	58 300	70 400
Gasoline	Motor Gasoline	18.9	1	69 300	67 500	73 000
	Aviation Gasoline	19.1	1	70 000	67 500	73 000
	Jet Gasoline	19.1	1	70 000	67 500	73 000
Jet Kerosene		19.5	1	71 500	69 700	74 400
Other Kerosene		19.6	1	71 900	70 800	73 700

- Excerpt from 2006 IPCC guidelines with some default emission factors
- Note the uncertainties given by the 95% confidence intervals

IPCC methodology
CO_2 Emissions



Two approaches:

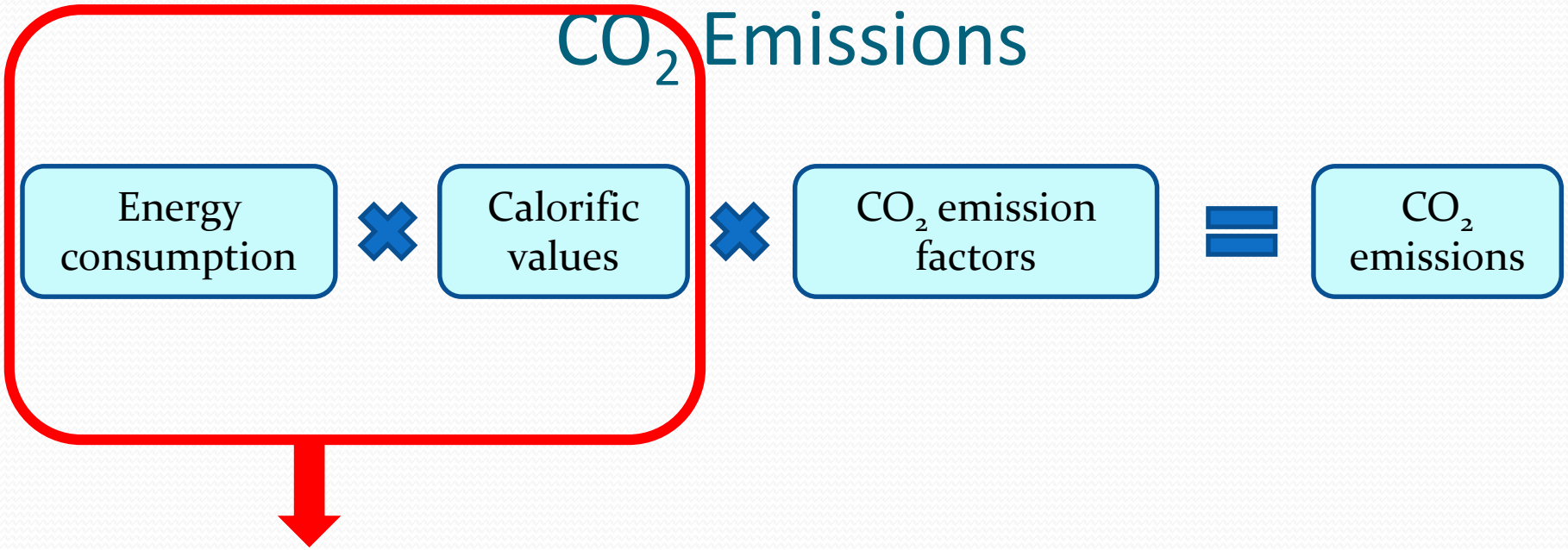
- Reference (or top-down) approach, based on TES
  - first-order estimate of national GHG emissions based on the energy supplied to a country
  - Quality check on the…
- Sectoral (or bottom-up) approach, based on (detailed) final consumption
  - The 3 tiers consider this approach

IPCC methodology
CO_2 Emissions

Sector	Energy				
Category	Fuel combustion activities				
Category Code	1A [(a)]				
Sheet	1 of 4 (CO_2, CH_4 and N_2O from fuel combustion by source categories – Tier 1)				
	Energy consumption			CO_2	
	A Consumption (Mass, Volume or Energy unit)	B Conversion Factor[(b)] (TJ/unit)	C Consumption (TJ)	D CO_2 Emission Factor (kg CO_2/TJ)	E CO_2 Emissions (Gg CO_2)
			C=A*B		E=C*D/10^6
Liquid fuels					
Crude Oil	10 kt (or Gg)	42 TJ/kt	420	73300	30.79
Orimulsion					
Natural Gas Liquids					
Motor Gasoline					
Aviation Gasoline					
Jet Gasoline					
Jet Kerosene					
Other Kerosene					

IPCC methodology

CO_2 Emissions



- Energy values: Captured in the energy balance
- From an energy balance, the multiplication by CO2 emission factors is straightforward, in order to arrive at CO2 emission estimates

country

Terajoules

	Primary coal and peat	Coal and peat products	Primary oil	Oil products	Natural gas	Biofuels and waste	Nuclear	Electricity	Heat	Total energy	*of which: renewable*
2016											
Primary prod.	3400		1234		345	4567	67	234	34	9881	4835
Imports	748	158	420	1024	180	10		81		2621	10
Exports	-319	-265	-101	-873	-40	-6		-12		-1616	-6
Int'l mar. bunkers				-28						-28	
Int'l av. bunkers				-78						-78	
Stock changes	-14		170	-81						75	
TES	**3815**	**-107**	**1723**	**-36**	**485**	**4571**	**67**	**303**	**34**	**10855**	**4839**

- Energy supply: basis for reference approach or top-down emission estimates
- Note relative weights of sources

	Coal and peat	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Electricity	Heat	Total*
Total final consumption	**3117**	**0**	**90009**	**55912**	**0**	**0**	**0**	**9766**	**44625**	**546**	**203975**
Industry	2450	0	6067	23876	0	0	0	5840	17698	545	56476
Transport	0	0	54404	2436	0	0	0	1637	331	0	58808
Other	33	0	8935	26208	0	0	0	2289	26596	0	64062
Residential	33	0	2647	14661	0	0	0	2279	13161	0	32782
Commercial and public services	0	0	3008	10823	0	0	0	10	12623	0	26464
Agriculture / forestry	0	0	3280	724	0	0	0	0	812	0	4816
Fishing	0	0	0	0	0	0	0	0	0	0	0
Non-specified	0	0	0	0	0	0	0	0	0	0	0
Non-energy use	634	0	20603	3392	0	0	0	0	0	0	24629

- Final consumption: basis for the sectoral approach or bottom-up emission estimates

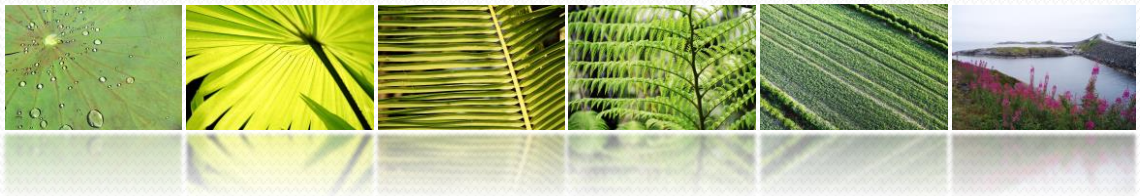
IPCC methodology Exclusions

- Note that CO2 emissions from biomass fuels (including non-fossil waste) are not included in the national total but are reported as an information item.
  - Note that peat is treated as a fossil fuel and emissions from its combustion are therefore included in the national total.
- Fuels used for non-energy purposes are not burned, and therefore do not emit CO2
  - For this reason, they are excluded from emission estimates
  - However, if and when they are recycled and burned (e.g., waste oil), then emissions should be properly account for
- Bunkers (int'l aviation and navigation) are excluded from national totals, but included in world totals
  - Few countries provide the split between domestic and international navigation/aviation

IPCC methodology
Importance of specific NCVs

	Coal (kt)	Default NCV	Specific NCVs	Coal (TJ) default NCV	Coal (TJ) specific NCV	Default emission factor for coal (t CO2/TJ)	CO2 (tons) default NCV	CO2 (tons) specific NCV
2012								
Primary production	131.8	25.8	20.10	3400	2649			
Imports	29.0	25.8	23.20	748	673			
Exports	-12.4	25.8	28.20	-319	-349			
Stock changes	-0.5	25.8	20.10	-14	-11			
Total energy supply	147.9			3,815	2,962	94.6	360,899	280,193

- 29% higher CO2 emission estimates by using default NCVs



Thank you.

http://unstats.un.org/unsd/greeneconomy/