

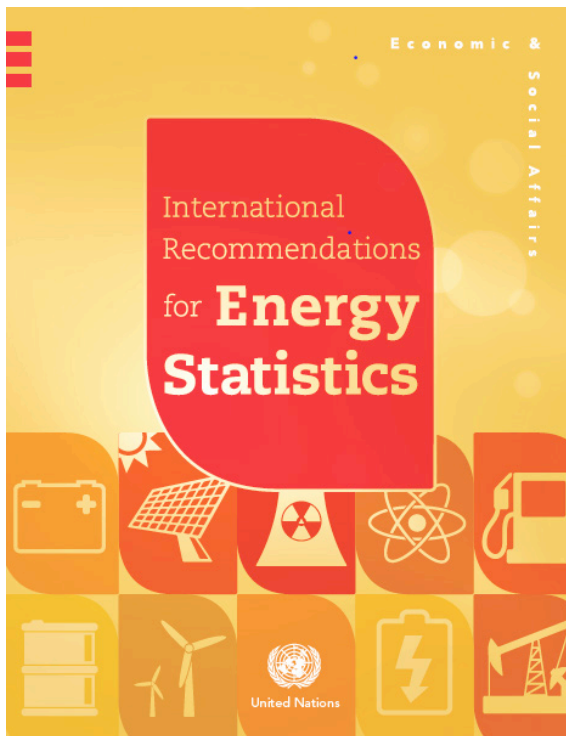


Fundamentals of energy balances

Pouya Taghavi – Energy Data Centre

Joint IEA UNEP UNFCCC Workshop on Energy Data for Climate Policy – 25th / 27th November 2020

Our reference: International Recommendations for Energy Statistics



International Recommendations for Energy Statistics (IRES)

- Internationally agreed and adopted by the UN Statistical Commission (2011) – implementation encouraged in all countries
- Comprehensive framework on: scope of energy statistics, classifications, units, methods; data collection, institutional arrangements, quality assurance, dissemination
- Importance of developing energy statistics as official statistics (UN Fundamental principles)

Energy balance includes the information required for estimating emissions



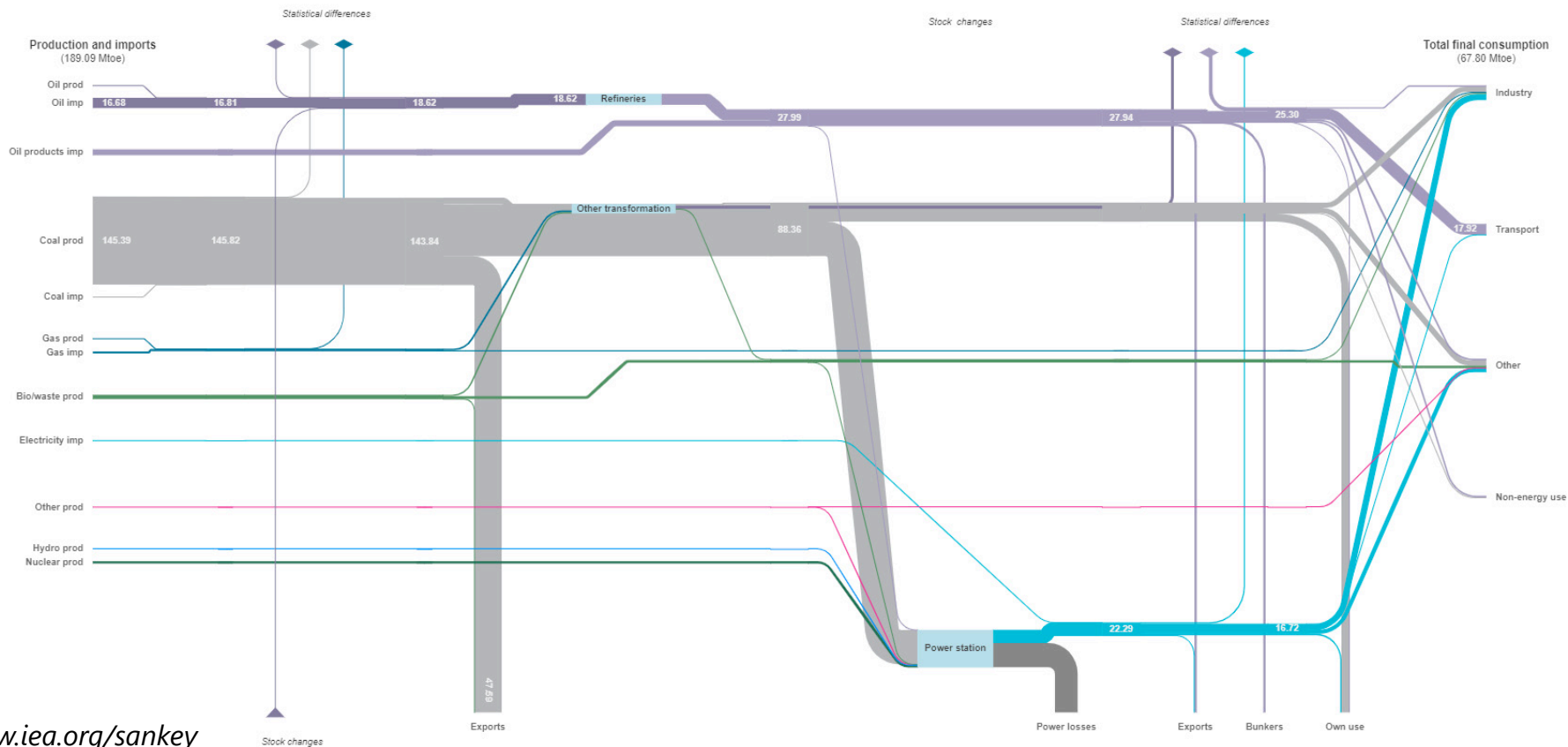
"...An accounting **framework** for compilation of data on **all energy products entering, exiting, and used** within the national territory of a given **country** during a reference period."

Understanding how energy flows across the country

South Africa

BALANCE (2017)

Millions of tonnes of oil equivalent



Energy balances are a compact source of information

		SUPPLY AND CONSUMPTION [unit]	Coal	Crude oil	Oil products	Natural Gas	Nuclear	Hydro	Geotherm solar etc.	Biofuels & Waste	Electricity	Heat	Total	
Demand	Supply	Production	39725	3597	-	8551	22052	1707	10974	31254	-	-	115920	
		Imports	39665	92632	39411	81613	-	-	-	889	2437	-	256646	
		Exports	-1401	-103	-22700	-19328	-	-	-	-	-1455	-6781	-3	-51771
		Intl. marine bunkers	-	-	-	-	-	-	-	-	-	-	-	-2790
		Intl. aviation bunkers	-	-	-	-	-	-	-	-	-	-	-	-8657
		Stock changes	-756	-	-	-	-	-	-	-	-	-	-	775
		TES	77233	-	-	-	052	1767	-	-	-	-	-3	310123
	Transformation and energy industries	Transfers	-	-	-	-	-	-	-	-	-	-	-	745
		Statistical differences	-1404	-	-	-	-	-	-	-	-	-	-	1123
		Electricity plants	-54256	-	-783	-3111	-22052	-1767	-10184	-5699	44631	-	-	-53220
		CHP plants	-6495	-	-436	-12100	-	-	-	-8434	10702	8127	-	-8635
		Heat plants	-332	-	-137	-2198	-	-	-38	-1347	-	-	3081	-970
		Blast furnaces	-5531	-	-32	-	-	-	-	-	-	-	-	-5564
		Gas works	-	-	-	-	-	-	-	-	-	-	-	-
		Cokep. fuel BKB/PP plants	-581	-	-355	-	-	-	-	-	-	-	-	-936
		Oil refineries	-	-104174	102579	-	-	-	-	-	-	-	-	-1595
		Petrochemical plants	-	5859	-6006	-	-	-	-	-	-	-	-	-148
		Liquefaction plants	-	-	-	-	-	-	-	-	-	-	-	-
		Other transformation	-	-	-	-	-	-	-	-	-	-	-	-
	Final consumption	Energy industry own use	-821	-	-5624	-1257	-	-	-	-	-535	-4288	-299	-12824
		Losses	-544	-	-	-	-	-	-	-	-23	-2215	-1125	-3906
		TFC	7268	-	-	-	-	-	-	-	-	1486	9782	224191
		INDUSTRY	6318	-	-	-	-	-	-	-	-	184	4273	55823
		TRANSPORT	-	-	-	-	-	-	-	-	-	09	-	56846
RESIDENTIAL		520	-	-	-	-	-	-	-	-	11023	4420	56010	
COMMERCIAL AND PUBLIC SERVICES		27	-	7009	10388	-	-	89	2327	12970	-	-	-	

Comparable information for all products

Comparable energy units

Three main “blocks” of flows

IEA 2020. All rights reserved.

IEA

Comparable information for all products

Comparable energy units

Three main "blocks" of flows

1st block: Energy supply

	Coal and peat	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Electricity	Heat	Total*
Production	33658	173317	0	132349	24390	32309	901	12106	0	0	409029
Imports	5954	34510	12790	25960	0	0	0	759	1287	0	81260
Exports				5831	0	0	0	-570	-4430	0	-239722
International marine bunkers				0	0	0	0	0	0	0	-524
International aviation bunkers				0						0	-1214
Stock changes				2092						0	3016
TES				3569	2439					0	251845

Producers	Mt	% of world total
United States	666	14.9
Saudi Arabia	575	12.8
Russian Federation	554	12.4
Canada	259	5.8
Iraq	231	5.2
Islamic Rep. of Iran	221	4.9
People's Rep. of China	188	4.2
United Arab Emirates	179	4.0
Kuwait	148	3.3
Brazil	135	3.0
Rest of the world	1 326	29.5
World	4 482	100.0

2018 provisional data

Net exporters	Mt
Saudi Arabia	348
Russian Federation	252
Iraq	187
Islamic Rep. of Iran	132
Canada	131
United Arab Emirates	118
Kuwait	103
Nigeria	89
Venezuela	82
Angola	75
Others	563
Total	2 088

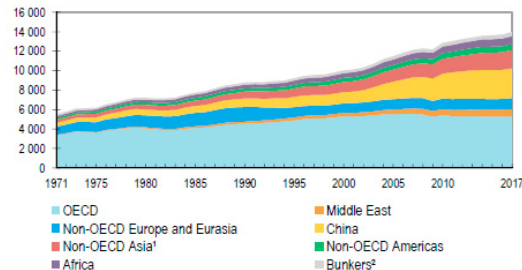
2017 data

Net importers	Mt
People's Rep. of China	415
United States	349
India	220
Japan	158
Korea	151
Germany	91
Italy	69
Spain	65
Netherlands	59
France	58
Others	527
Total	2 162

2017 data

World total primary energy supply by region

World TPES from 1971 to 2017 by region (Mtoe)



Source: IEA, Key World Energy Statistics, 2019

“High-level” information: production, trade, total energy supply ...

Energy supply data are the basis for the reference approach estimate

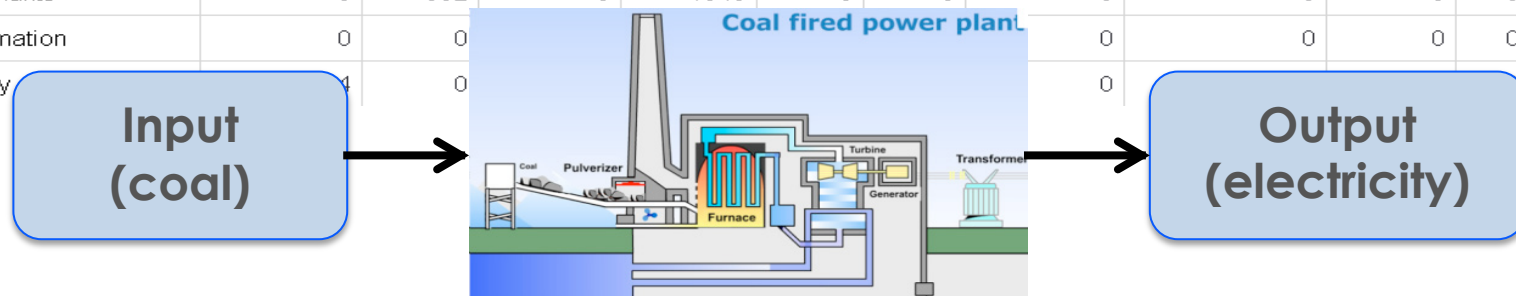
CRF Table 1.A(b)

FUEL TYPES			Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption	Conversion factor (TJ/Unit) ¹	NCV/ GCV ⁽²⁾	Apparent consumption (TJ)	
Liquid fossil	Primary fuels	Crude oil	kt	670.47	8333.37	NO		33.84	8970.00	42.50	NCV	381224.83	
		Orimulsion	kt	NO	NO	NO		NO	NO	NO	NCV	NO	
		Natural gas liquids	kt	17.74	NO	NO		NO	17.74	42.50	NCV	753.96	
	Secondary fuels	Gasoline	kt		730.88	1060.26	NO	-49.34	-280.04	40.98	NCV	-11475.72	
		Jet kerosene	kt		82.93	19.19	803.16	-7.09	-732.32	43.30	NCV	-31709.51	
		Other kerosene	kt		0.80	0.11	NO	0.00	0.69	43.30	NCV	29.86	
		Shale oil	kt		NO	NO		NO	NO	NO	NCV	NO	
		Gas/diesel oil	kt			5064.91	1007.93	13.39	-25.40	4068.99	42.45	NCV	172719.36
		Residual fuel oil	kt			65.34	466.77	NO	-16.95	-384.49	41.15	NCV	-15821.68
		Liquefied petroleum gases (LPG)	kt			62.35	85.77		-1.47	-21.94	46.12	NCV	-1012.02
		Ethane	kt			IE	IE		IE	IE	NO	NCV	NO,IE
		Naphtha	kt			NO	186.45		5.89	-192.34	45.01	NCV	-8657.17
		Bitumen	kt			313.38	187.47		0.30	125.61	41.80	NCV	5250.29
		Lubricants	kt			143.60	108.93	NO	0.15	34.52	41.80	NCV	1442.97
		Petroleum coke	kt			62.84	0.48		-1.15	63.51	30.26	NCV	1921.76
		Refinery feedstocks	kt			101.11	95.18		4.40	1.53	42.79	NCV	65.48
		Other oil	kt			64.31	6.00		-0.08	58.40	46.01	NCV	2687.03
Other liquid fossil													
Liquid fossil totals											497419.44		

Same product classification and flow definitions thanks to international harmonisation provided by the IPCC Guidelines

2nd block: Transformation and energy sectors

	Coal and peat	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Electricity	Heat	Total*
Electricity plants	-17629	0	-1820	-10824	-24390	-32309	-901	-2426	53814	0	-36484
CHP plants	0	0	-41	-2468	0	0	0	-39	958	544	-1047
Heat plants	0	0	0	0	0	0	0	-62	0	34	-28
Gas works	0	0	0	0	0	0	0	0	0	0	0
Oil refineries	0	-91737	95461	-849	0	0	0	0	0	0	2875
Coal transformation	-1182	0	0	0	0	0	0	0	0	0	-1182
Liquefaction plants	0	802	0	-1940	0	0	0	0	0	0	-1138
Other transformation	0	0					0	0	0	0	0
Energy industry	4	0					0				-25966



Transformation of primary fuels to secondary commodities and own use of energy sector

3rd block: Final consumption

	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
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

Deliveries of energy products to all final consumers for energy or non-energy purposes

Estimating emissions, supply vs demand side approaches

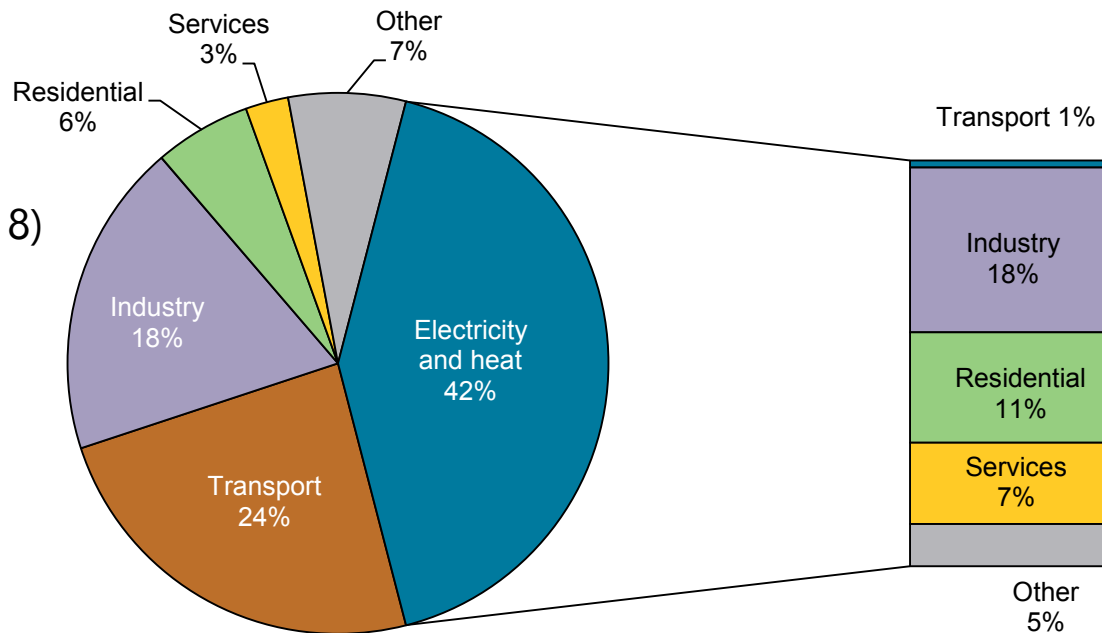
CRF Table 1.A(c)

FUEL TYPE	Supply side estimate			Demand side estimate	
	REFERENCE APPROACH			SECTORAL APPROACH ⁽¹⁾	
	Apparent energy consumption ⁽³⁾	Apparent energy consumption (excluding non-energy use, reductants and feedstocks) ⁽⁴⁾	CO ₂ emissions	Energy consumption	CO ₂ emissions ⁽⁵⁾
	(PJ)	(PJ)	(kt)	(PJ)	(kt)
Liquid fuels (excluding international bunkers)	2169.58	2043.14	141418.98	2053.98	140790.10
Solid fuels (excluding international bunkers)	1847.24	1751.78	158053.54	1770.52	160050.33
Gaseous fuels	1530.19	1476.24	75592.00	1469.95	75300.24
Other fossil fuels	NA	NO	NA	0.00	0.06
Peat	NA	NO	NA	NO	NO
<i>Total⁽⁵⁾</i>	5547.00	5271.16	375064.52	5294.44	376140.74

It is good practice to apply both a supply side and demand side approach to estimate CO₂ emissions

Key sectors driving the CO₂ emissions trend

Total emissions: 33.5 GtCO₂ (2018)



Source: IEA - CO₂ Emissions from fuel combustion, 2020

Power generation, industry and transport together, are responsible for over 80% of the global CO₂ emissions from fuel combustion



Questions?

Balances@iea.org