The importance of energy balances to estimate greenhouse gas emissions

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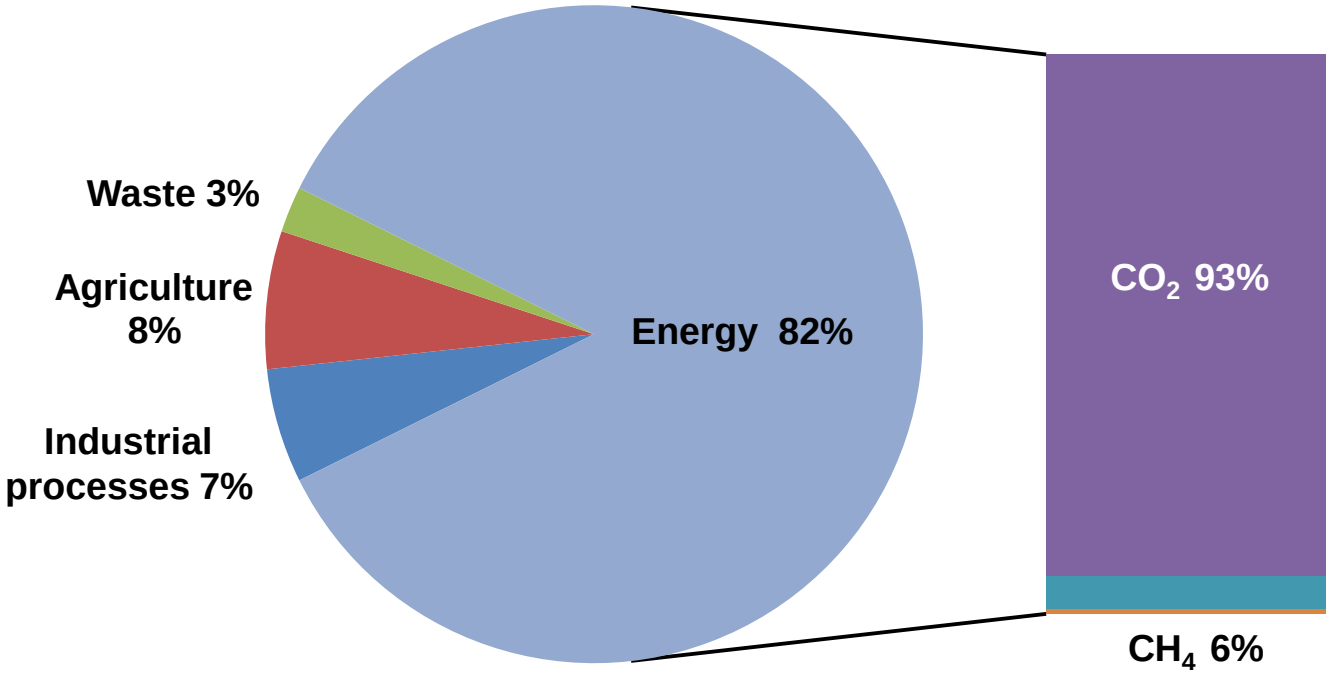
Mainstreaming Energy Sustainable Development Goals (SDGs), Targets and Indicators into Statistical Programmes in Select African Countries

Addis Ababa, June 2016

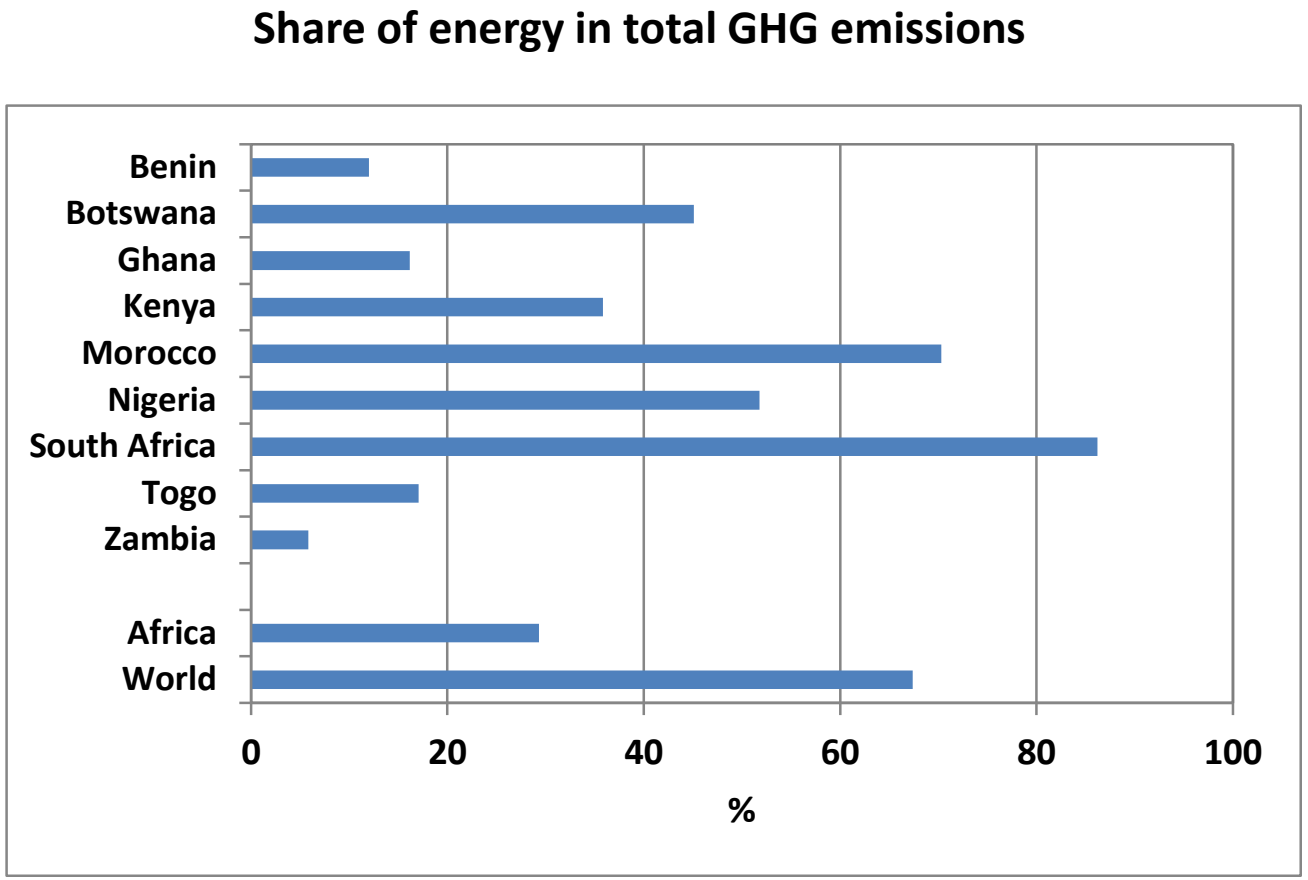
What sectors drive GHG emissions?



Source: UNFCCC - based on Annex I only countries data for 2012

Generally, energy-related CO_2 dominate GHG emissions

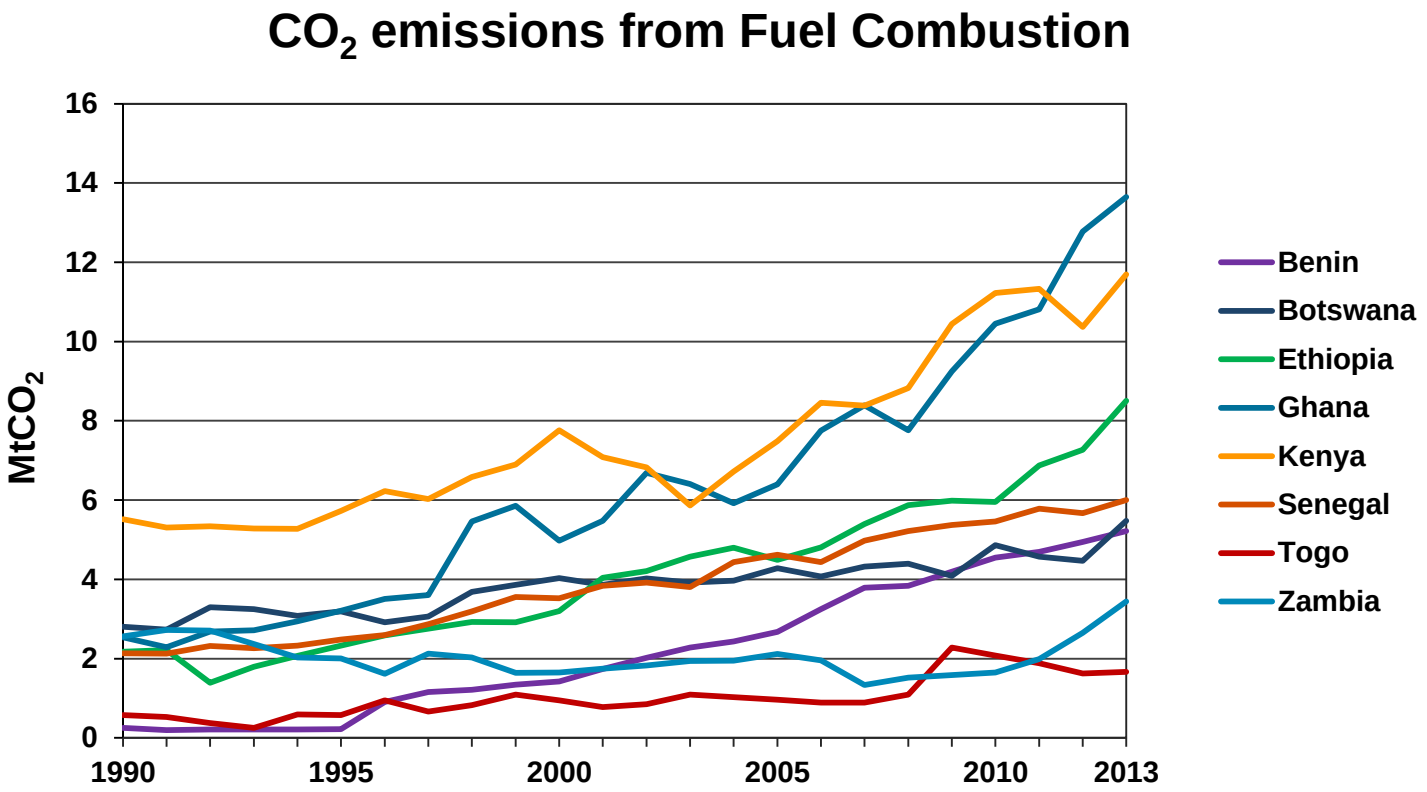
Even if the energy sector weight varies across countries….



Source: IEA / EDGAR estimates, 2015

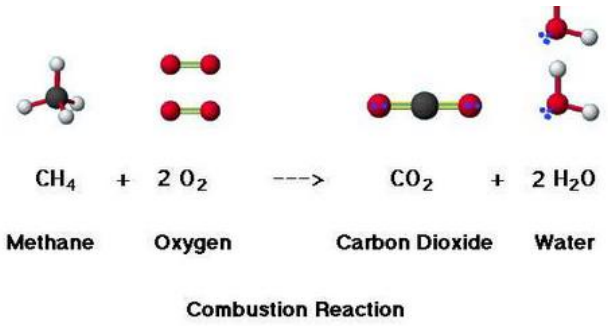
Always need to consider country circumstances

… The emissions from energy are predominantly CO_2



Source: IEA CO_2 emissions from fuel combustion, 2015

Why are energy balances relevant to estimate CO_2 emissions?



Estimating CO_2 emissions using IPCC methodologies: carbon conservation in combustion

MODULE	ENERGY				
CATEGORY	FUEL COMBUSTION ACTIVITIES				
CATEGORY CODE	1A (FOR EACH SOURCE CATEGORY)				
SHEET	CO_2, CH_4 AND N_2O FROM FUEL COMBUSTION BY SOURCE CATEGORY – TIER 1				
	Energy consumption			CO_2	
	A Consumption (Mass, Volume or Energy unit)	B Conversion Factor (TJ/unit)	C Consumption (TJ)	CO_2 Emission Factor (Kg CO_2/TJ)	CO_2 emissions (Gg CO_2)
			C=(AxB)		E=(CxD)
Other Kerosene					
Gas/Diesel Oil					
Residual Fuel Oil					

Energy consumption x **Calorific values** x **CO_2 emission factors** = **CO_2 Emissions**

Source: 2006 IPCC Guidelines

Note: all renewables sources - including biofuels- are not emitting (IPCC)

CO_2 emissions estimates rely on energy balances and underlying energy statistics quality

201· ▼ | Indicators | Balances | Coal and Peat | Electricity and Heat | Natural Gas | Oil | Renewables and Waste

	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						59	1287	0	81260
Exports	-20076	-118761						70	-4430	0	-239722
International marine bunkers**	0	0						0	0	0	-524
International aviation bunkers**	0	0	-1214	0	0	0	0	0	0	0	-1214
Stock changes	66	1064	-206	2092	0	0	0	0	0	0	3016
TPES	19603	90130	-8207	83569	24390	32309	901	12295	-3144	0	251845
Transfers	0	-3781	7993	0	0	0	0	0	0	0	4213
Statistical differences	2329	4585	4579	2410	0	0	0	-1	0	-32	13872
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
Liquefication plants	0	802	0	-1940	0	0	0	0	0	0	-1138
Other transformation	0	0	0	0	0	0	0	0	0	0	0
Energy industry own use	-4	0	-7956	-13986	0	0	0	-1	-4019	0	-25966
Losses	0	0	0	0	0	0	0	0	-2984	0	-2984
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

Energy sources

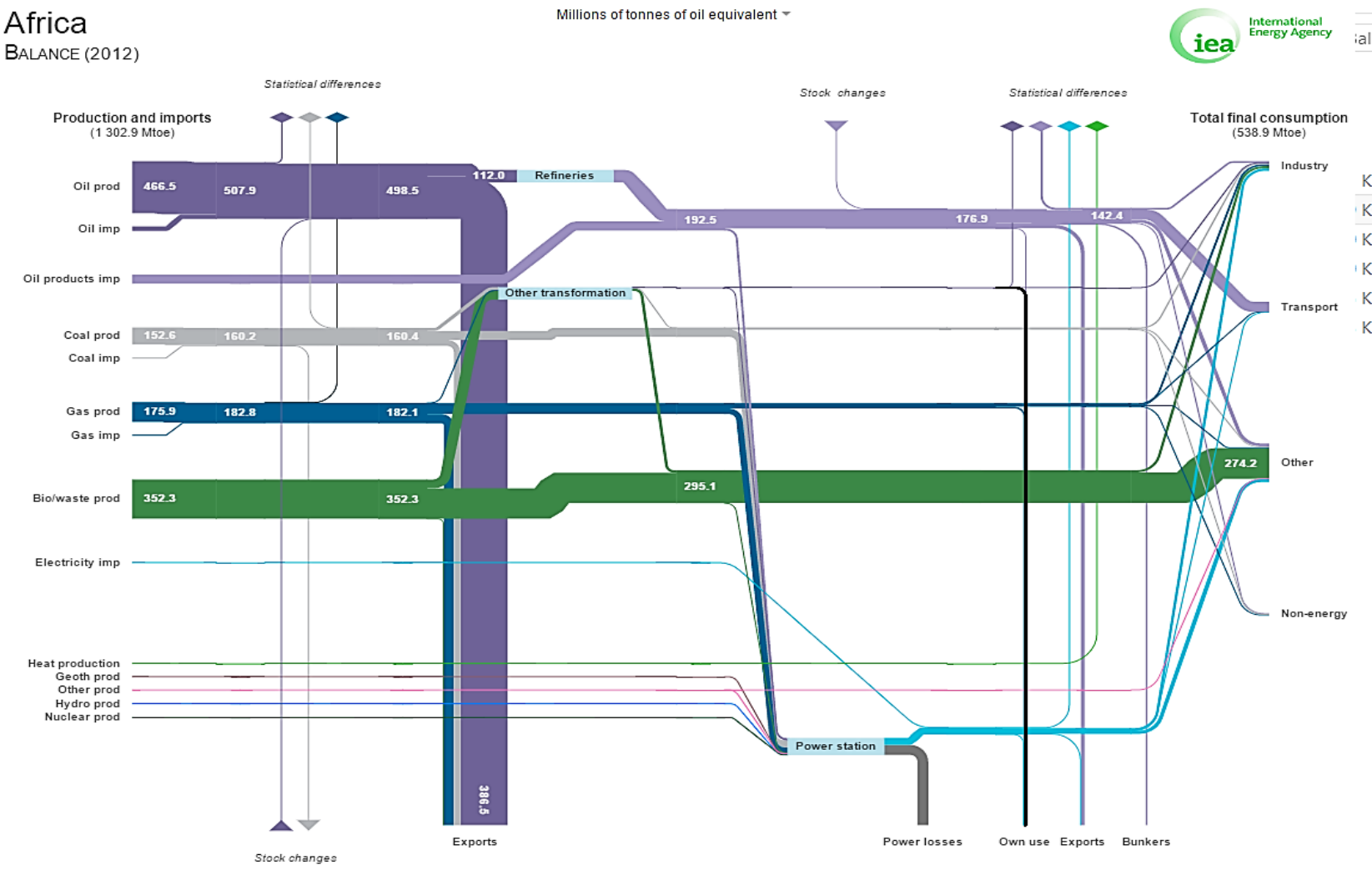
Supply

Transformation

Final consumption

The importance of accurate energy data and calorific values by product and by sector (three blocks)

What is an energy balance?



Source: IEA, World Energy Balances, 2015

The overall description of energy supply and use in a country

Examples of key emissions indicators derived from energy balances

Supply

Transformation

Final consumption

201· ▼ | Indicators | Balances | Coal and Peat | Electricity and Heat | Natural Gas | Oil | Renewables and Waste

	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	-20076	-118761	-19053	-76831	0	0	0	-570	-4430	0	-239722
International marine bunkers**	0	0	-524	0	0	0	0	0	0	0	-524
International aviation bunkers**	0	0	-1214	0	0	0	0	0	0	0	-1214
Stock changes	66	1064	-206	2092	0	0	0	0	0	0	3016
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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
Liquefication plants	0	802	0	-1940	0	0	0	0	0	0	-1138
Other transformation	0	0	0	0	0	0	0	0	0	0	0
Energy industry own use	-4	0	-7956	-13986	0	0	0	-1	-4019	0	-25966
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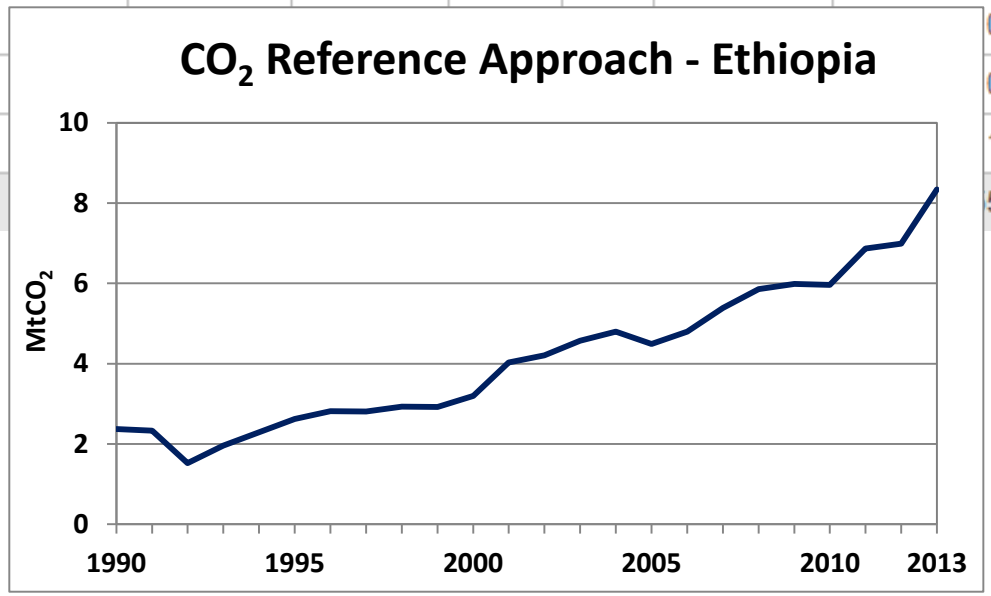
Commercial and public services	0	0	3008	10823	0	0	0	10	12623	0	26464
Agriculture / forestry	0	0	3280	724	0	0	0	0	812	0	4816
Fishing	0	0	0	0	0	0	0	0	0	0	0
Non-specified	0	0	0	0	0	0	0	0	0	0	0
Non-energy use	634	0	20603	3392	0	0	0	0	0	0	24629
-of which petrochemical feedstocks	*0*	*0*	*12022*	*3392*	*0*	*0*	*0*	*0*	*0*	*0*	*15415*

1: Energy supply

Ethiopia: Balances for 2013

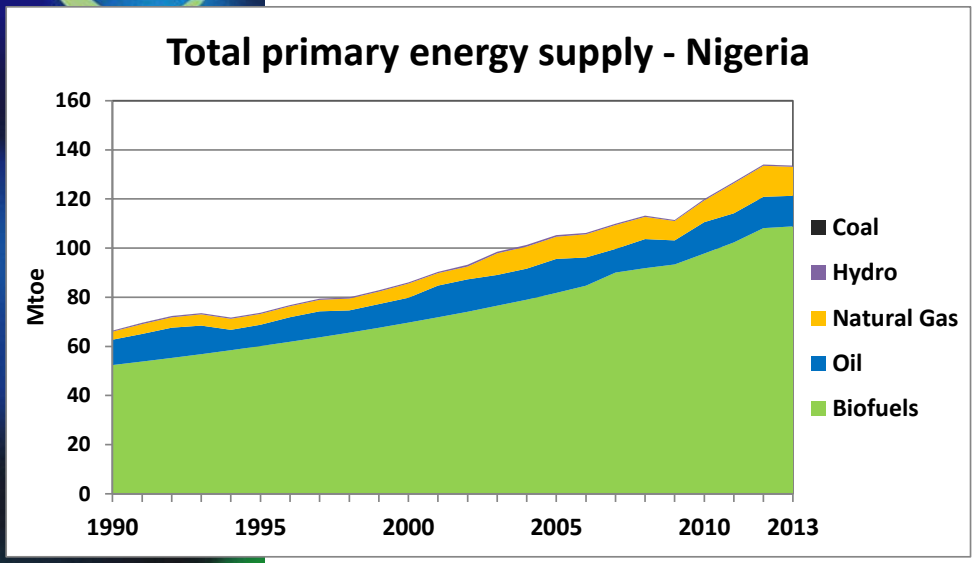
	Coal*	Crude oil*	Oil products	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Electricity	Heat	Total**
Production	0	0	0	0	0	717	45	44554	0	0	45317
Imports	179	0	2923	0	0	0	0	0	0	0	3102
Exports	0	0	0	0	0	0	0	0	-82	0	-82
International marine bunkers***	0							0	0	0	0
International aviation bunkers***	0							0	0	0	-373
Stock changes	0							1	0	0	25
TPES	**179**							5	-82	0	47939

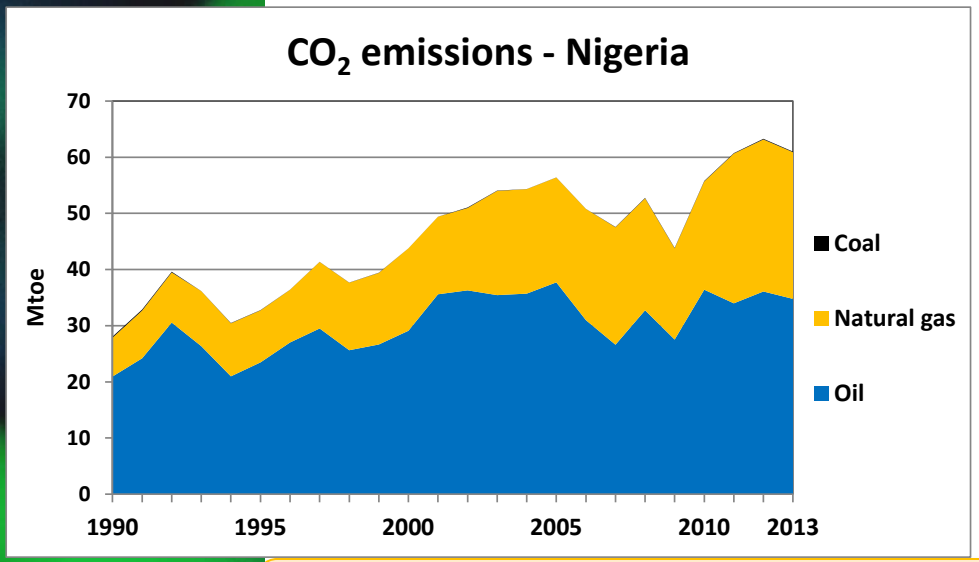


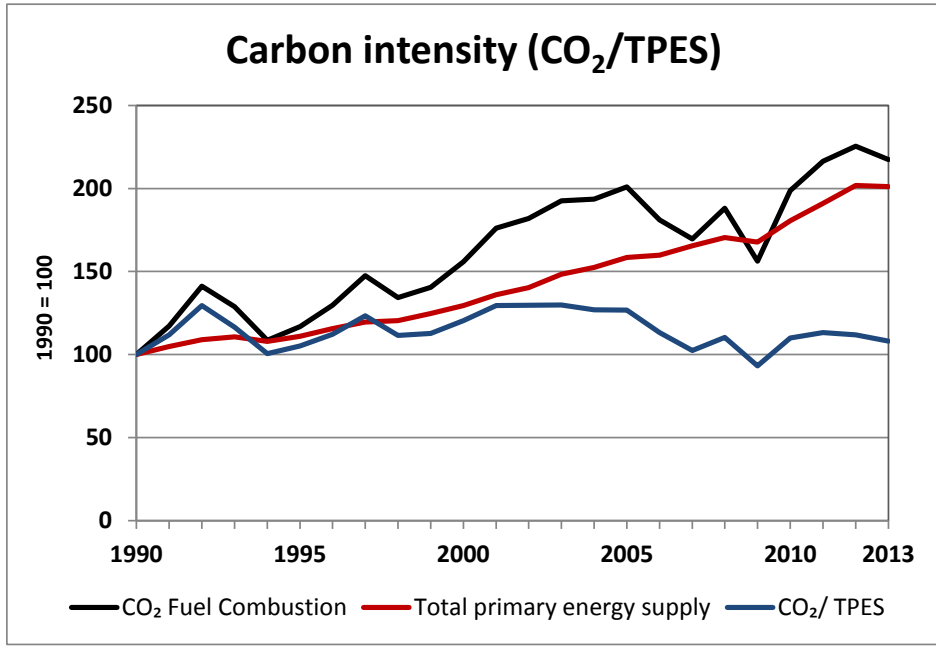
Sources: IEA World Energy Balances, 2015
IEA CO_2 emissions from fuel combustion, 2015

Basis for "reference approach" emissions ("top-down") and quick indicator of overall trends (few data needed)

Carbon intensity of the energy supply

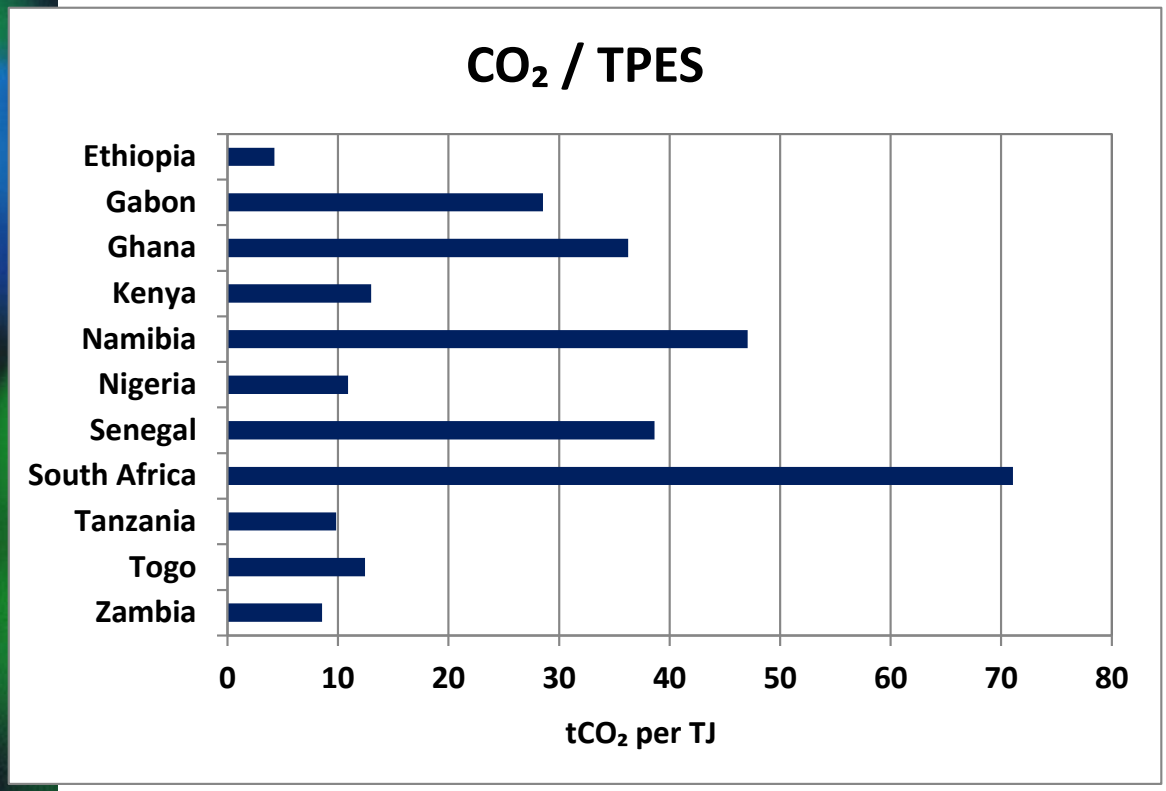






CO2/TPES: How much CO_2 for a given unit of energy supply?

Carbon intensity varies depending on the energy mix



Total CO_2/TPES Weighted average across supply sources

Source: IEA CO_2 emissions from fuel combustion, 2015

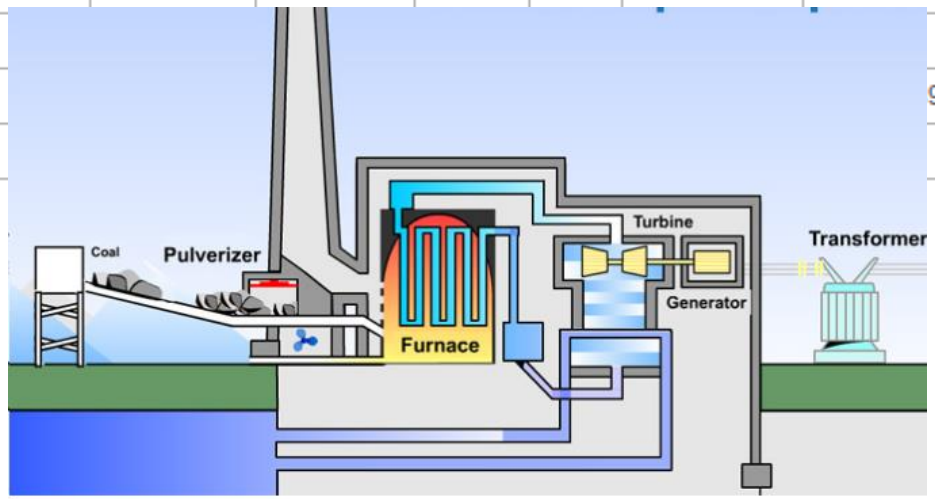
Need accurate supply data for all fuels – including solid biofuels!

2: Transformation sector

	Coal*	Crude oil*	Oil products	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Electricity	Heat	Total**
Electricity plants	-59185	0	-47	0	-3676	-100	-24	-102	21775	0	-41360
CHP plants	0							0	0	0	0
Heat plants	0							0	0	0	0
Gas works	-4639							0	0	0	-4639
Oil refineries	0	-22768	22970	0	0	0	0	0	0	0	203
Coal transformation	-1674	0	0	0	0	0	0	0	0	0	-1674
Liquefication plants	1981							0			2059
Other transfor	0							98			3
Energy indust	246										1
Losses	0										3

Transforming energy sources

Input (e.g. coal)

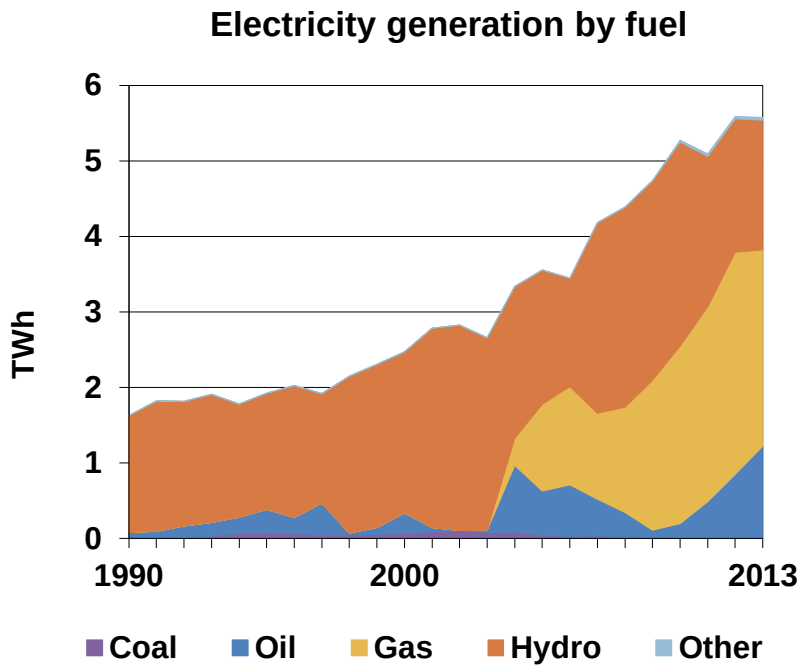


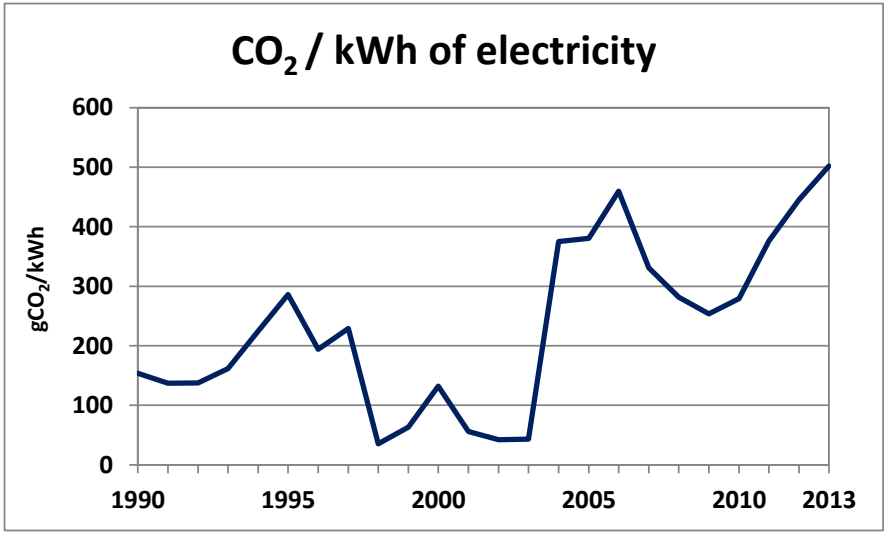
Output (electricity)

Need accurate input/output data by product type (e.g. electricity generation)

Carbon intensity of electricity (CO2/kWh)

United Republic of Tanzania

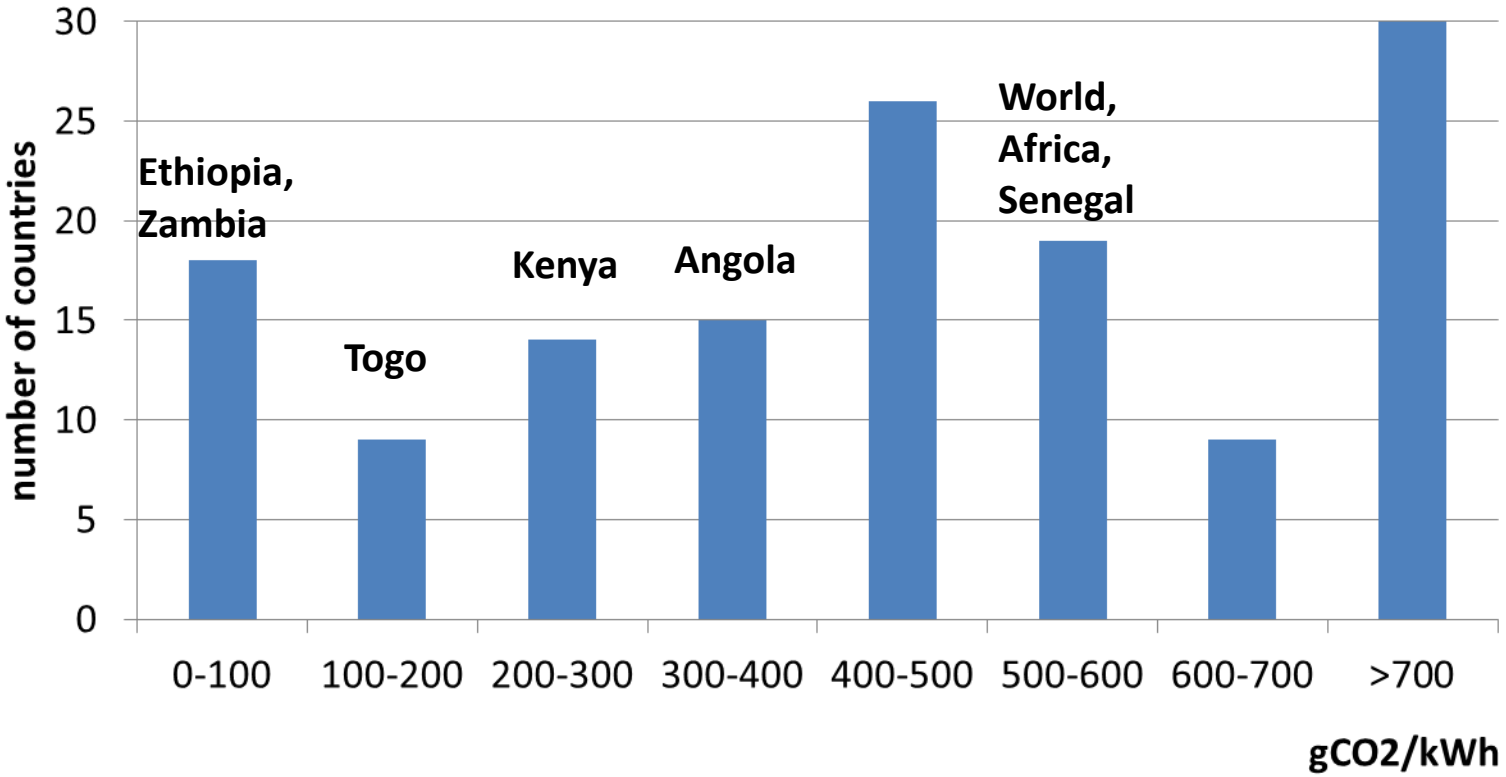




Source: IEA CO_2 emissions from fuel combustion, 2015

CO2/kWh: how much CO2 per unit of total electricity generated?
Total CO2 emissions / total electricity output
(including output from non emitting sources)

“carbon intensity of electricity” depends on the electricity mix and on the efficiency of generation



More fossil electricity

Less efficient generation

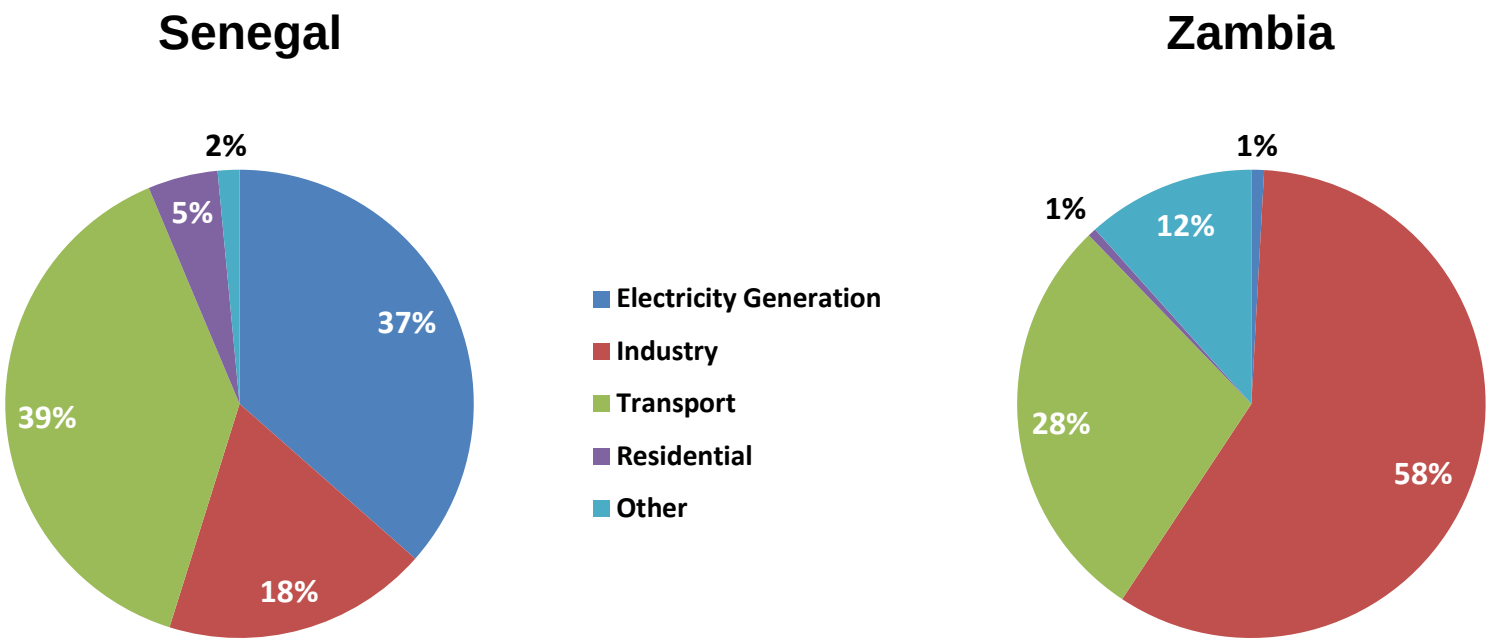
Need accurate data on amounts of combusted fuels and of electricity generated, by source

3: 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**
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**

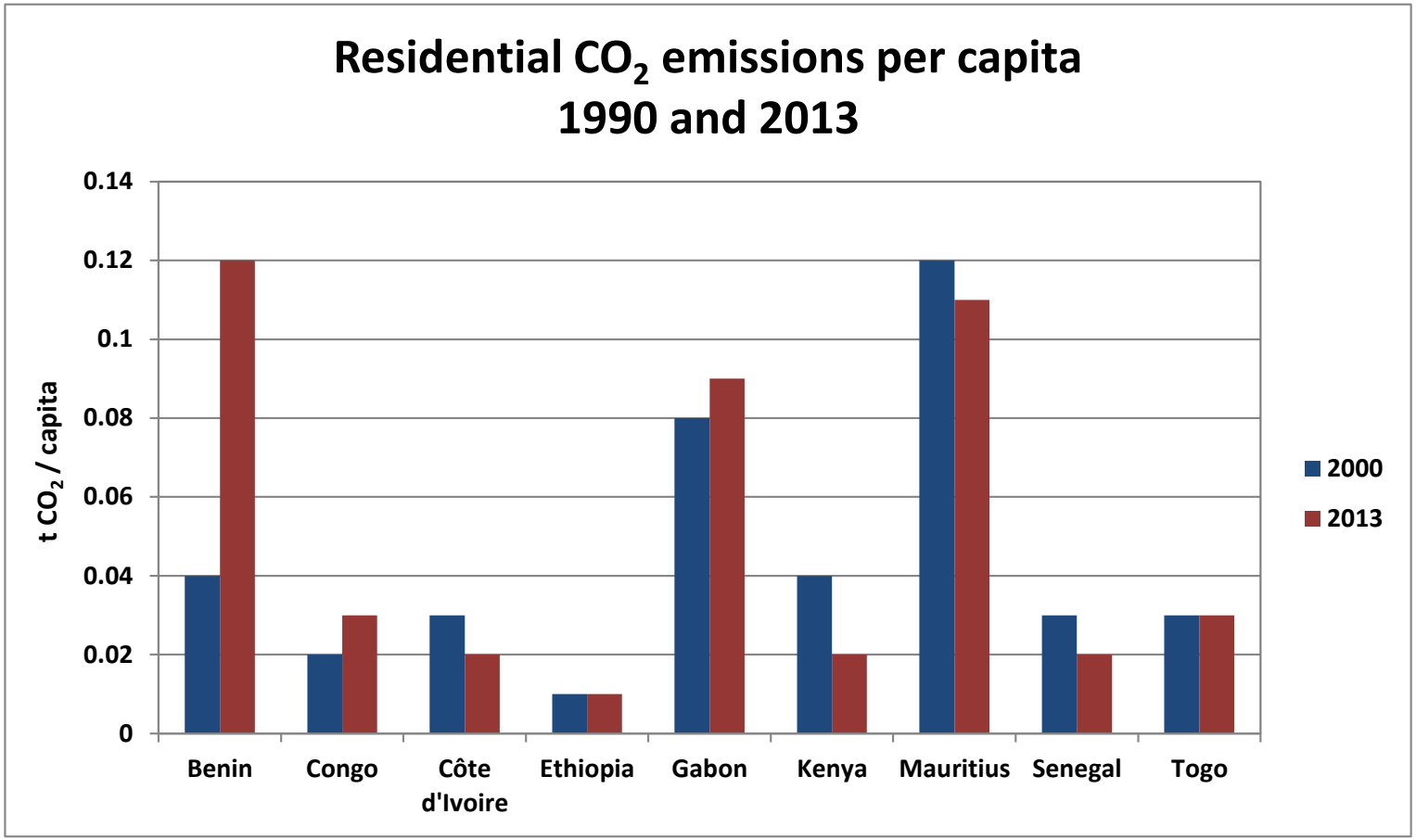
Basis for "Sectoral approach" (official) emissions estimates ("bottom-up") – different levels of detail possible

“Demand” indicators: shares by sector



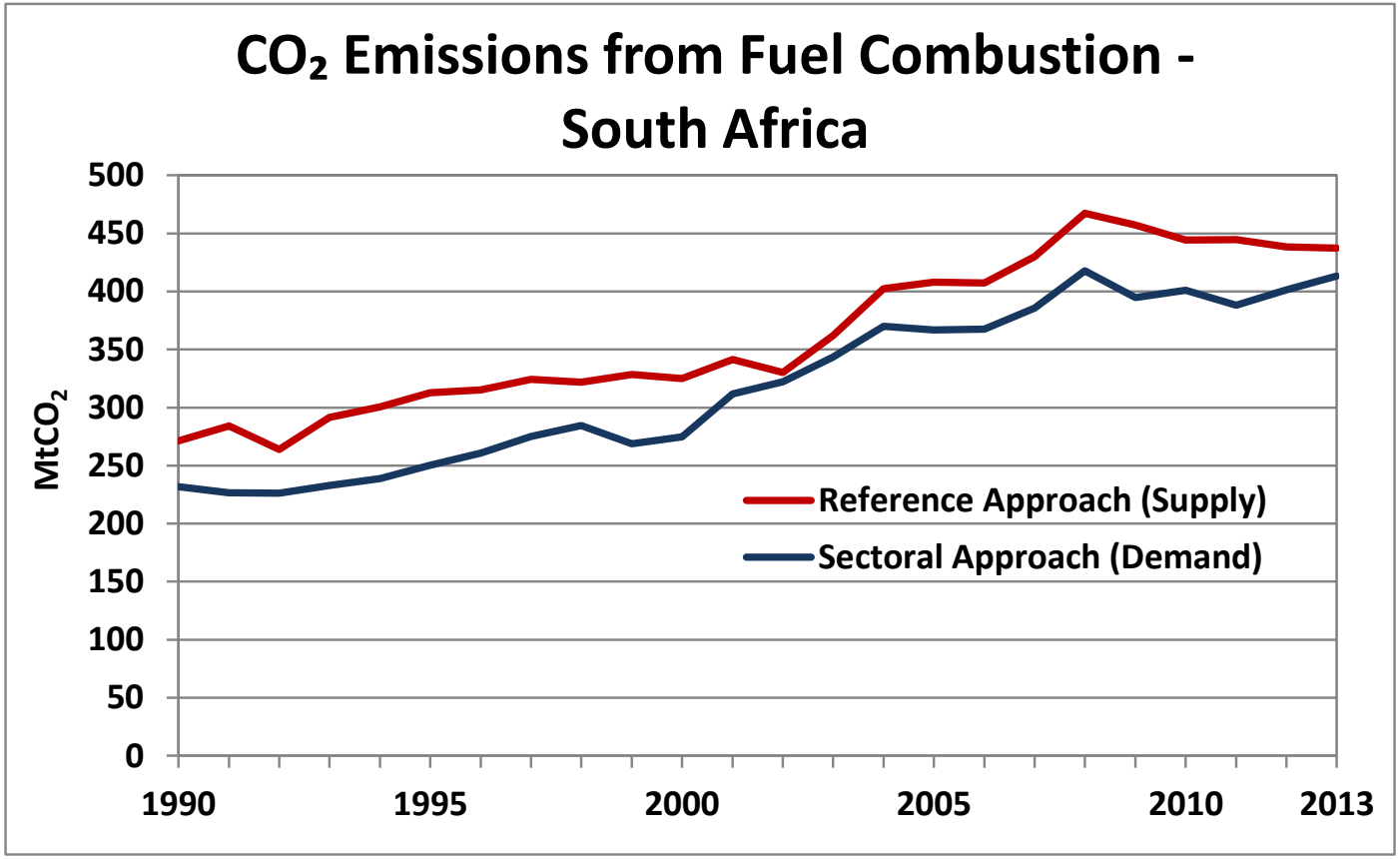
What sectors (and end uses) drive national emissions?
The importance of demand side data

A set of indicators can be computed at sectoral and sub-sectoral level



Source: IEA, CO_2 emissions from fuel combustion, 2015

A data quality assessment example: reconciling supply and demand sides



Generally, indicators are a tool to enhance data quality