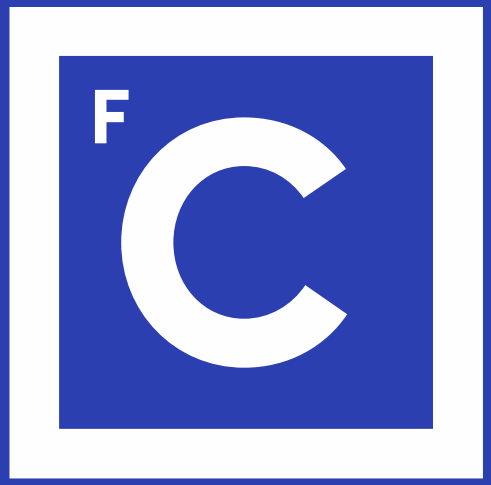


Ciências ULisboa

Faculdade
de Ciências
da Universidade
de Lisboa

DISCIPLINA MIEA 2019

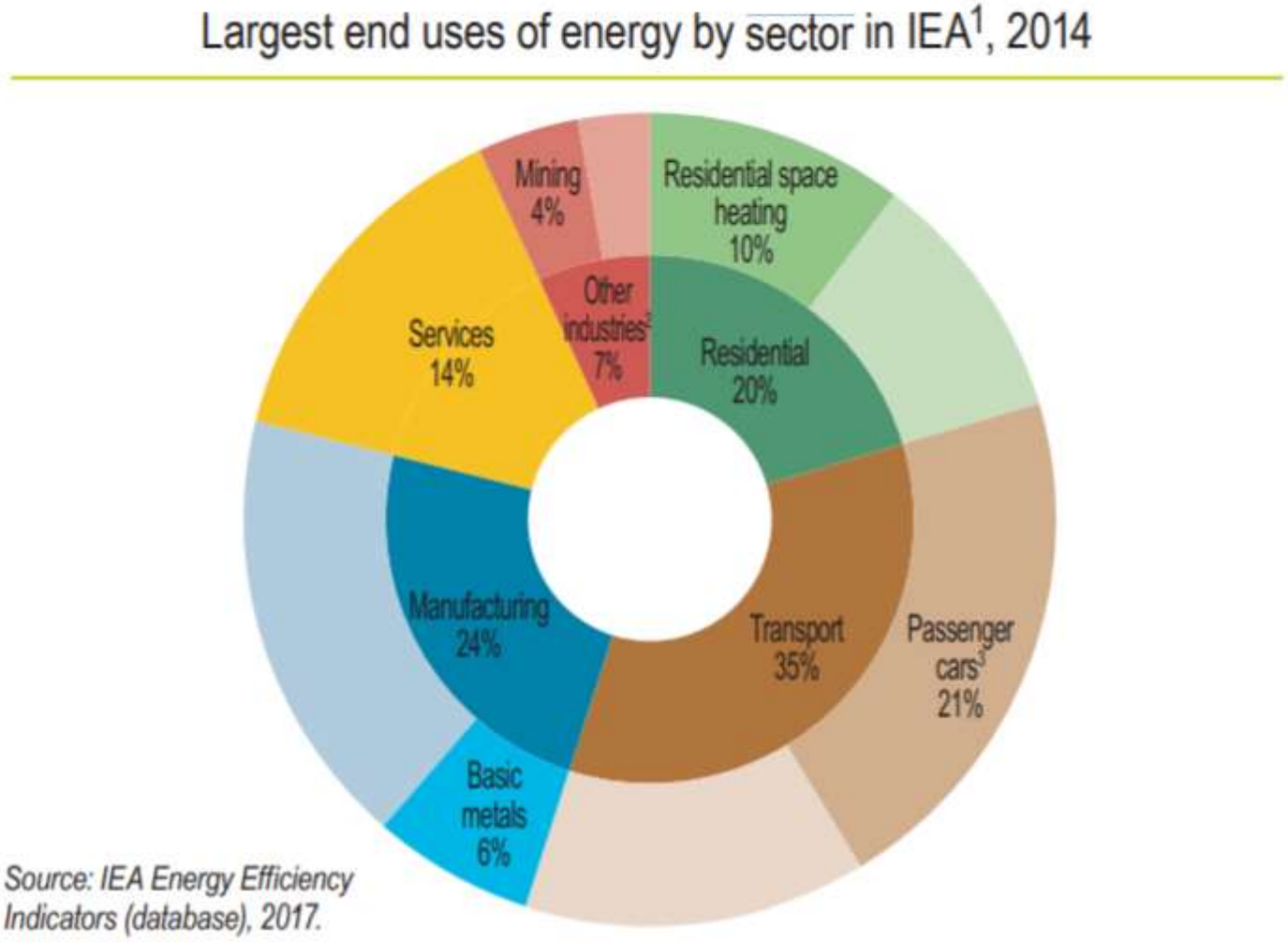
Mobilidade Sustentável

What is sustainable mobility?

Comparing transport systems??

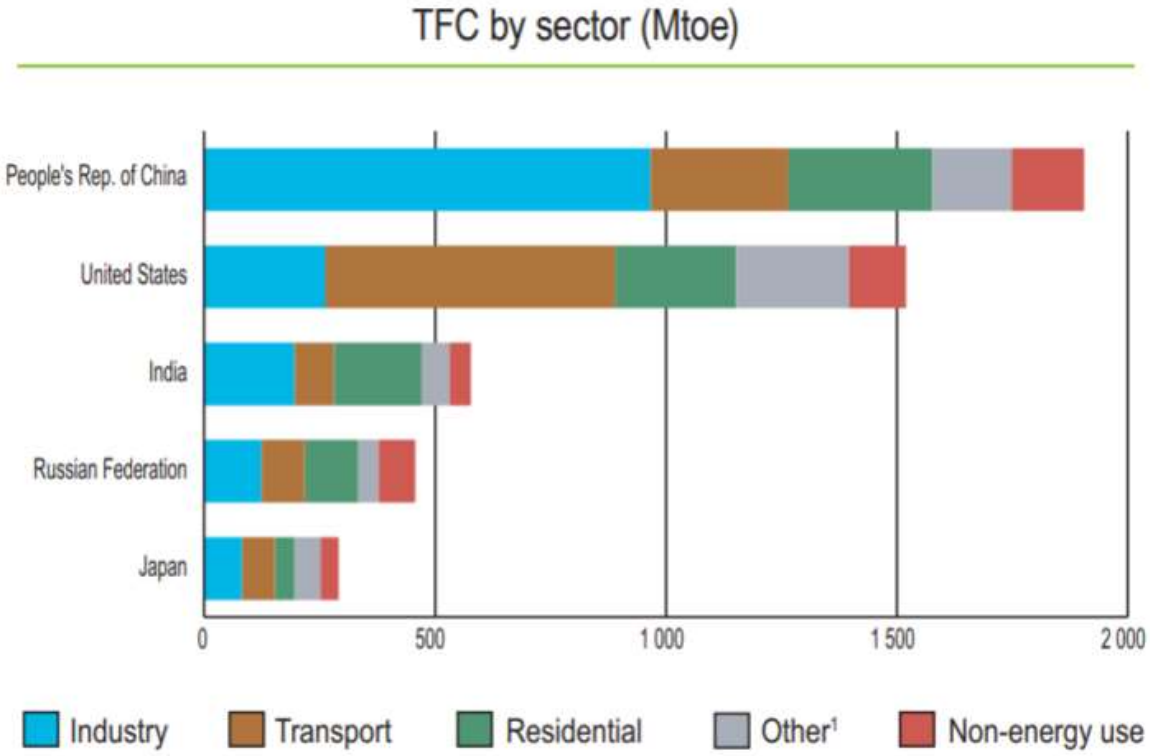
Sustainable mobility indicators

Transports share

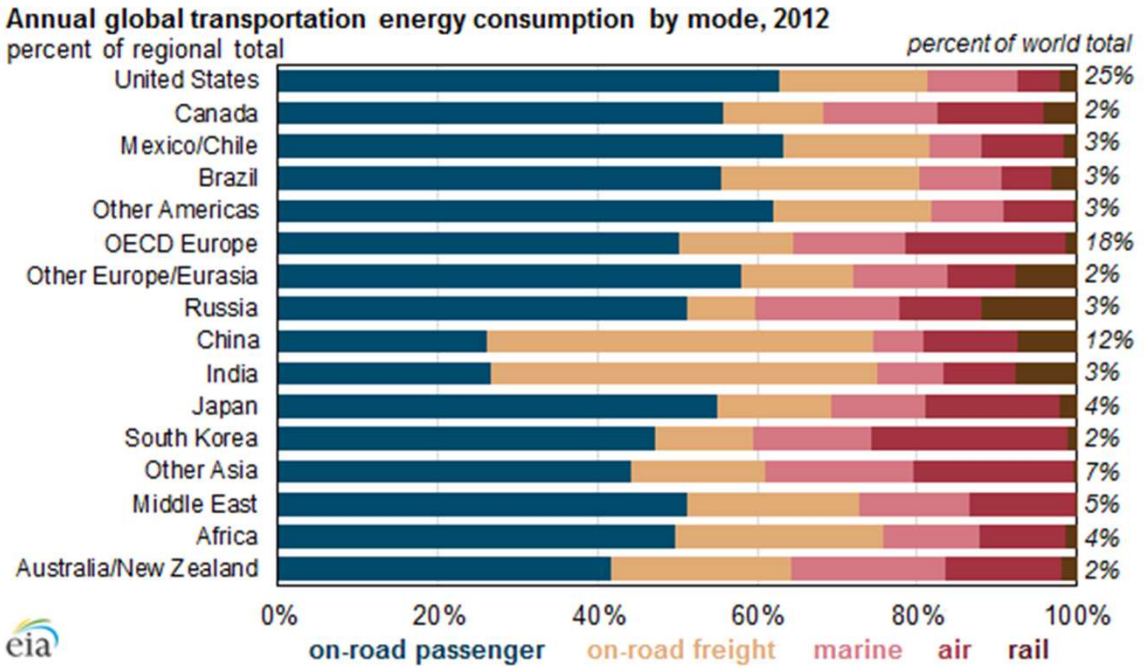


Transports share

Top five countries by total final consumption



Transports mode share

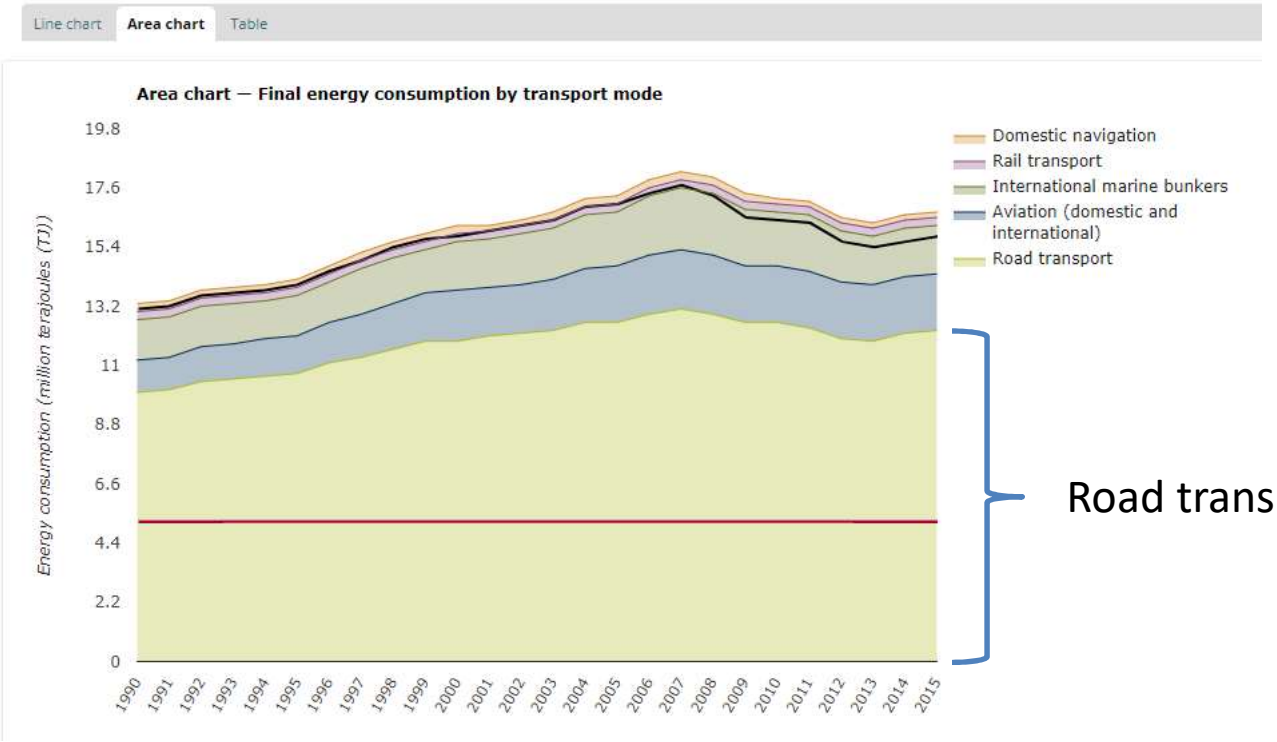


Source: EUROSTAT
http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Energy_consumption_of_transport_by_mode_EU-28.jpg

Transports mode share

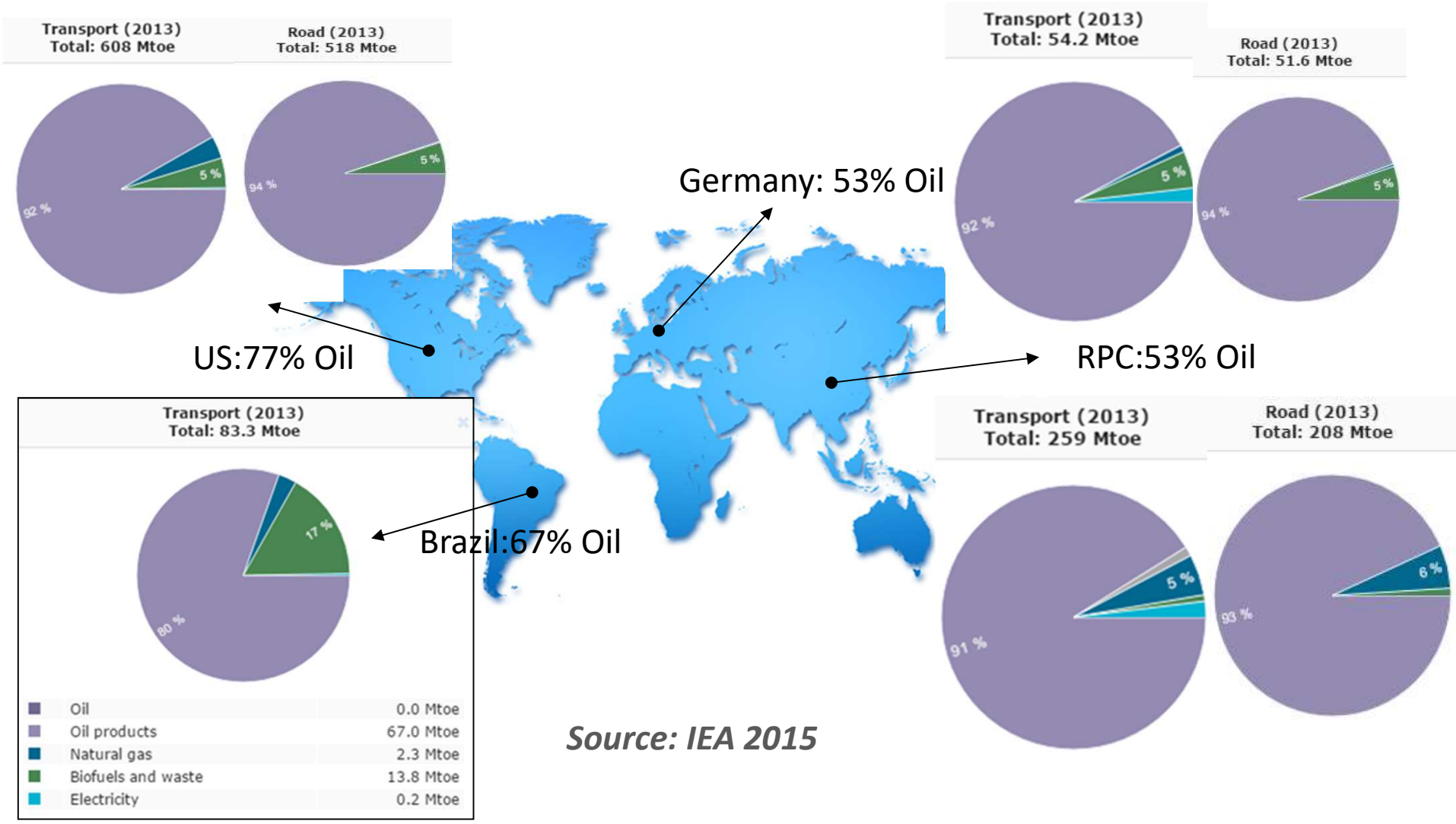
European Environment Agency

Fig. 1: Final energy consumption by transport mode



Road transport

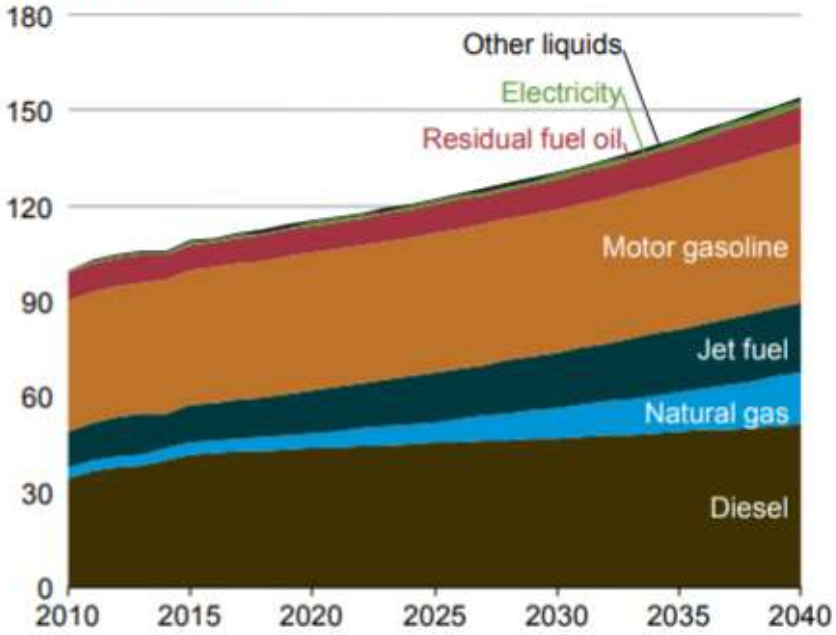
Transports share by energy source



Source: IEA 2015

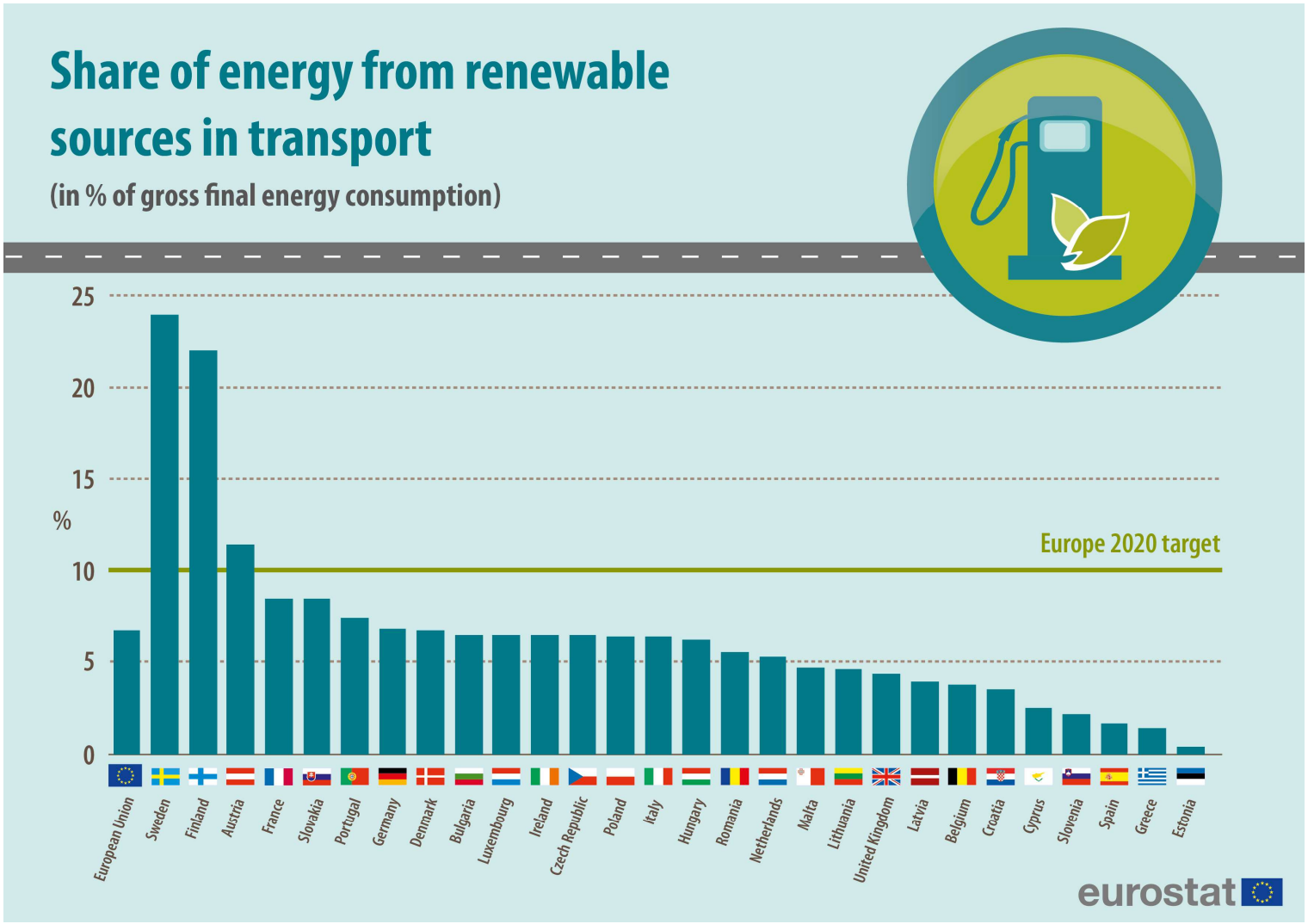
Transports share by energy source

Figure 8-2. World transportation sector delivered energy consumption by energy source, 2010–40 (quadrillion Btu)

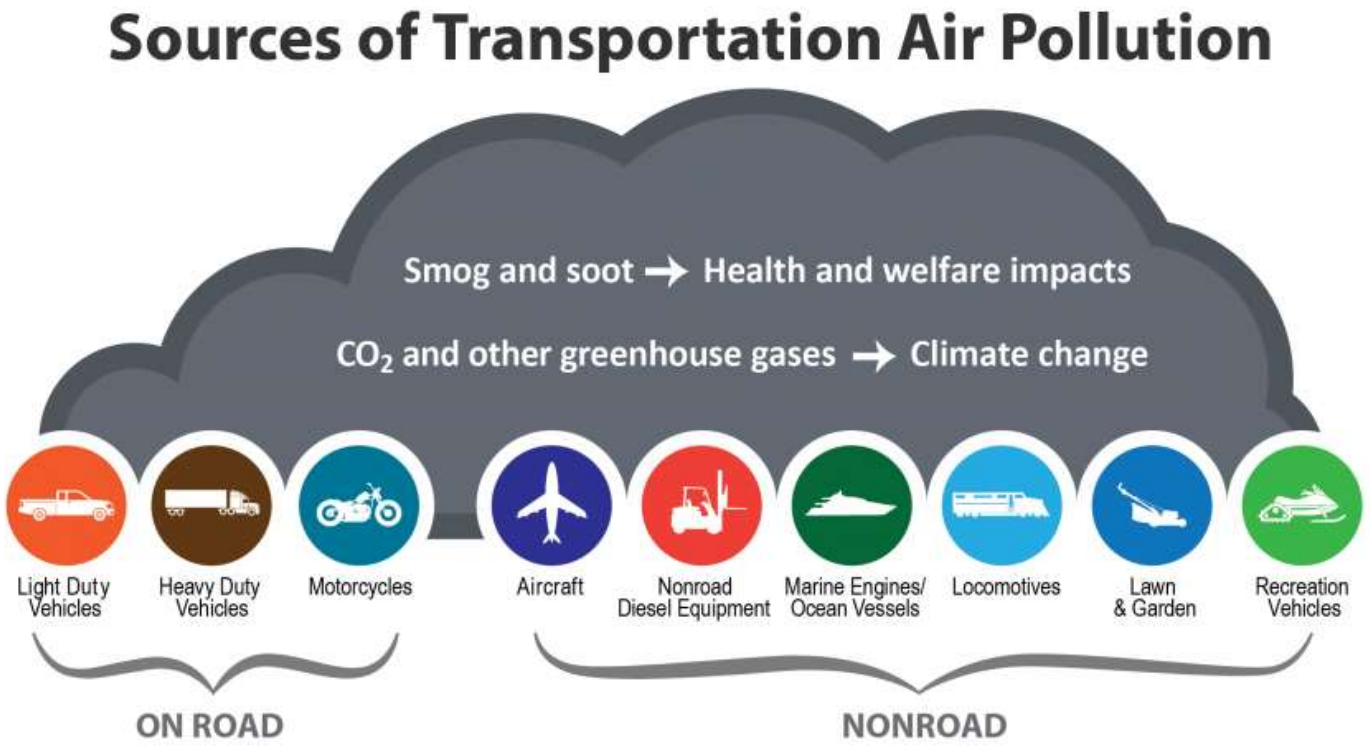


eia

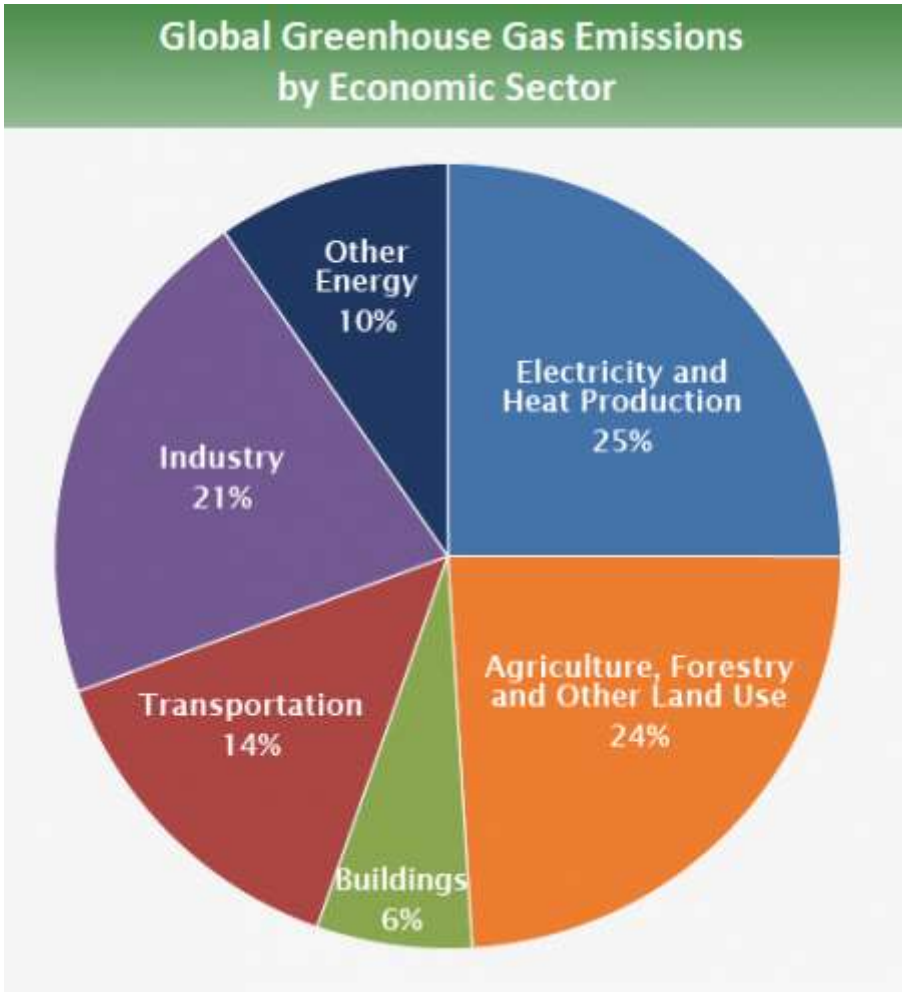
Transports share by energy source



Transports share by energy source



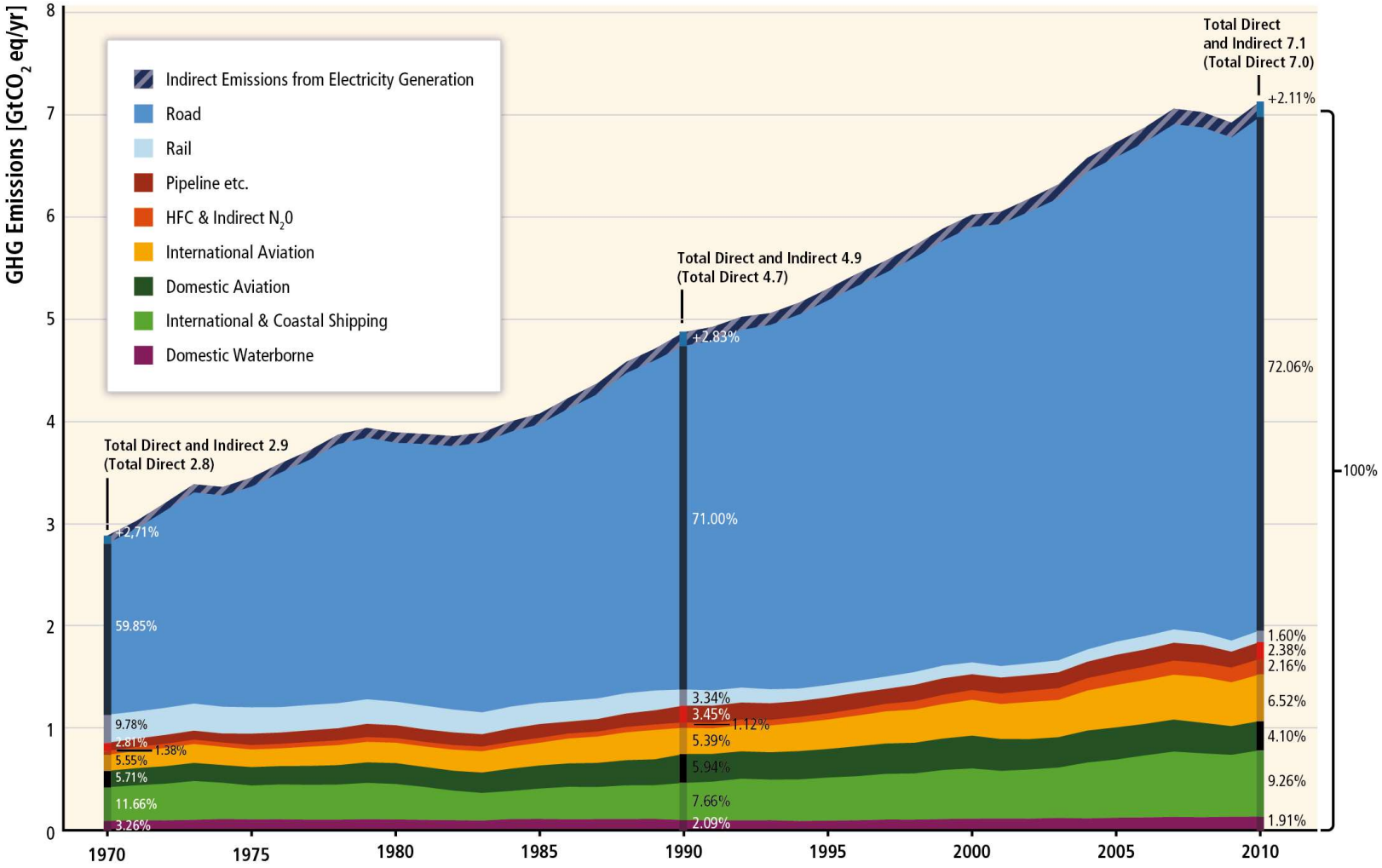
Transport share



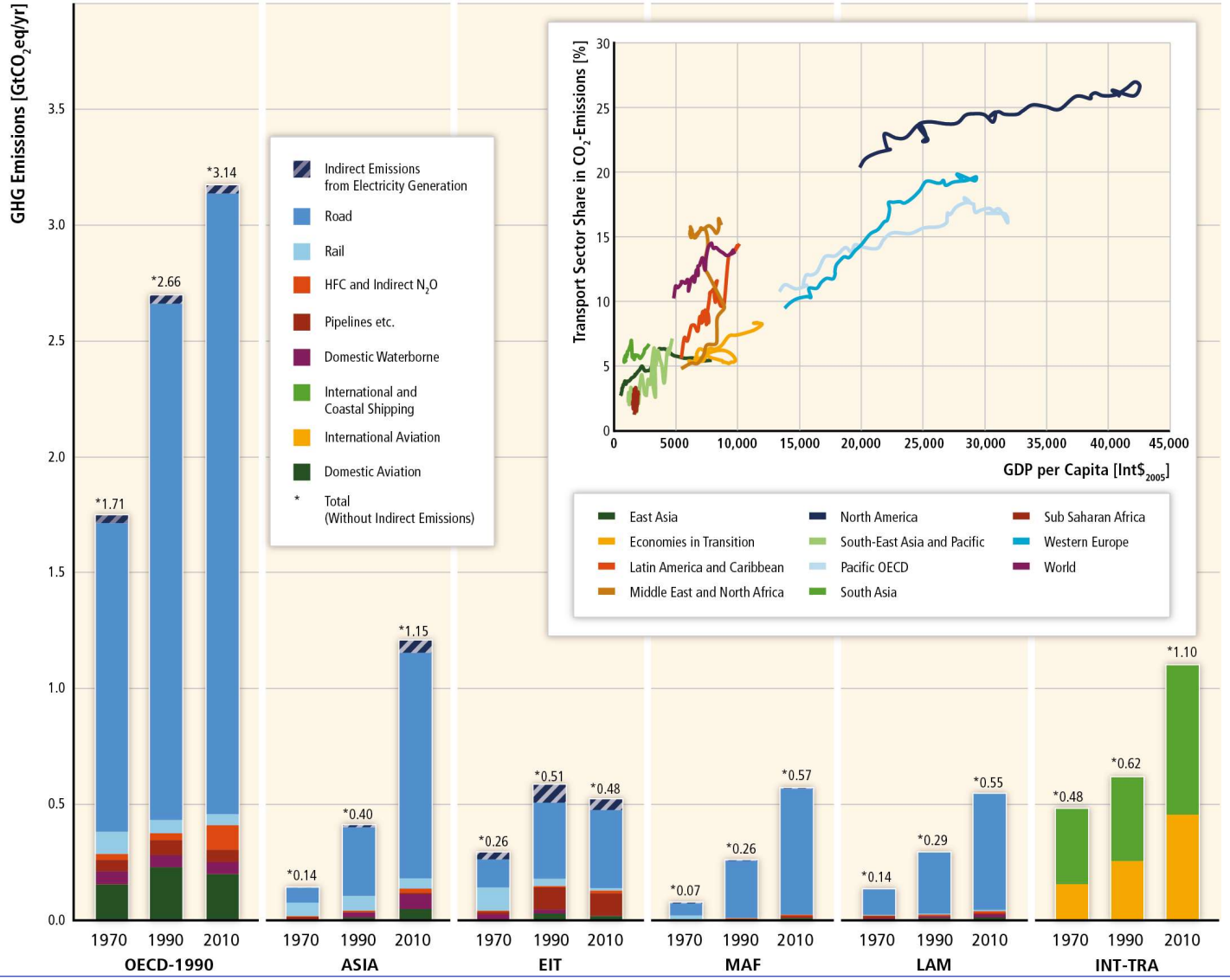
Source: IPCC (2014); EXIT based on global emissions from 2010. Details about the sources included in these estimates can be found in the Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

Transport share

IPCC (2014)

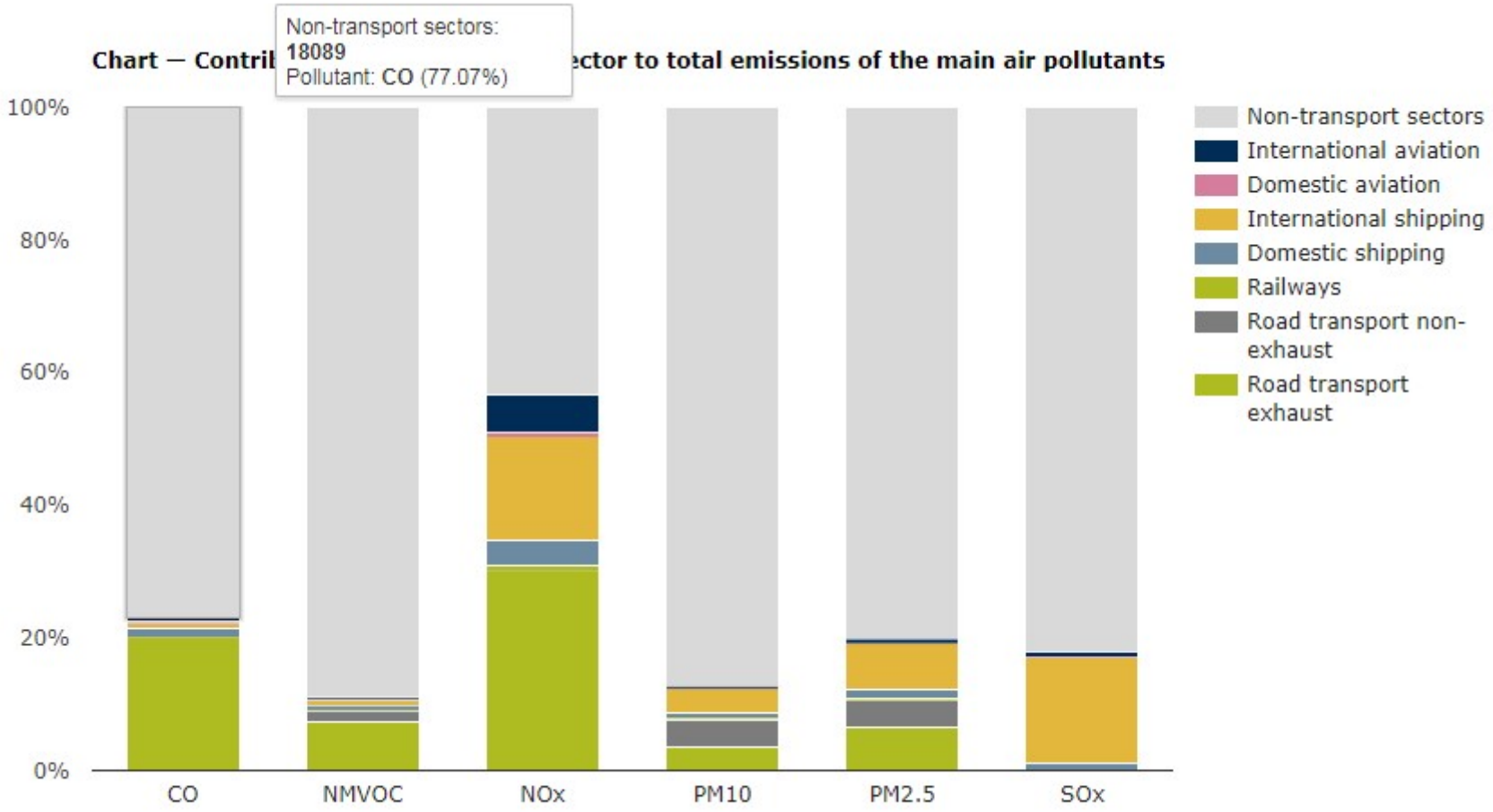


Transport share



IPCC (2014)

Transport share



2017

European Environment Agency

Transports share

LOCAL AIR QUALITY EMISSIONS (EUROPE)

					NON-TRANSPORT	
NOx	32.9%	0.9%	19.1%	4.5%	NOx	42.6%
CO	26.6%	0.2%	2.3%	0.7%	CO	70.2%
SOx	0.1%	0.0%	20.9%	0.5%	SOx	78.5%
VOLATILE ORGANIC COMPOUNDS	15.4%	0.14%	2.52%	0.40%	VOLATILE ORGANIC COMPOUNDS	81.54%
FINE PARTICLES (PM2.5)	14.2%	0.4%	11.4%	0.6%	FINE PARTICLES (PM2.5)	73.4%

In % of total emissions | source: European Environment Agency, 2013

THANKS TO IMPROVEMENTS IN AIRCRAFT TECHNOLOGY, THE IMPACT OF AIRCRAFT EMISSIONS ON LOCAL AIR QUALITY IS RELATIVELY LOW COMPARED TO OTHER SOURCES.

Minimum energy and emissions

Home ⟷ **Work (or university)**

Commuting

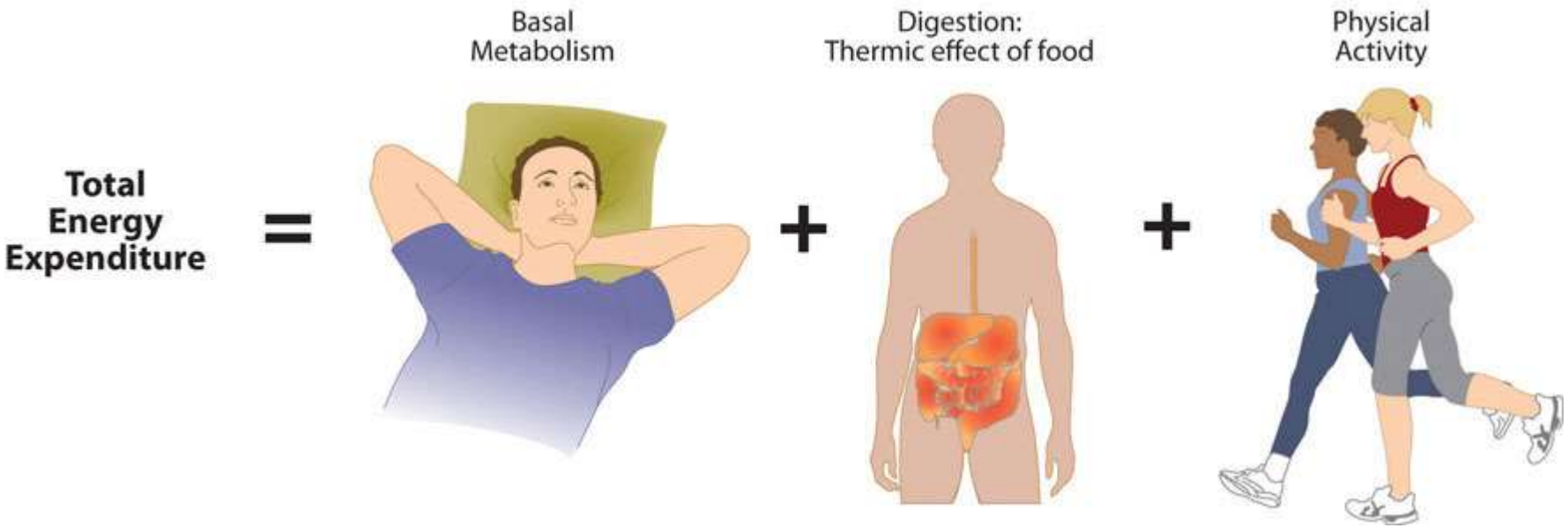
Minimum energy and emissions

Emissions

Energy

Mobility baseline

Walking….always….speed? Energy????Emissions???



Mobility baseline

Walking….always….speed? Energy????

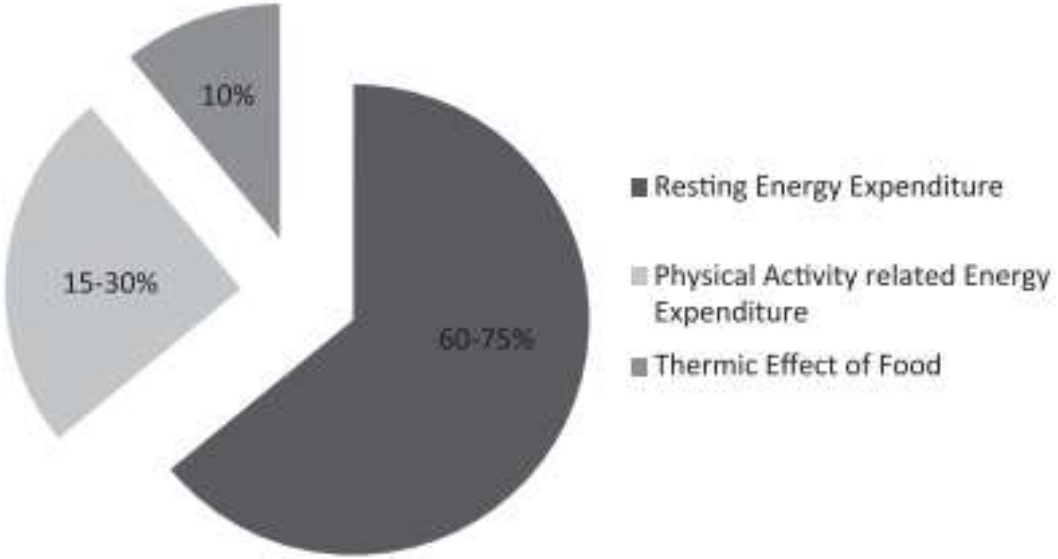


Figure 1. Components of typical total daily energy expenditure. Resting energy expenditure indicates the energy needed to maintain vital life functions during basal and sleeping conditions; physical activity–related energy expenditure, the energy needed to maintain movement demand above that of resting conditions; and thermic effect of food, the energy required for purposes of digestion and the breakdown of food stuff. Modified from McArdle et al.[21]

History…..and…future

Walking….always….speed? Energy????Emissions???

The Revised Harris-Benedict Equation:

- for men, $P = \left(\frac{13.397m}{1\,\text{kg}} + \frac{4.799h}{1\,\text{cm}} - \frac{5.677a}{1\,\text{year}} + 88.362 \right) \frac{\text{kcal}}{\text{day}}$
- for women, $P = \left(\frac{9.247m}{1\,\text{kg}} + \frac{3.098h}{1\,\text{cm}} - \frac{4.330a}{1\,\text{year}} + 447.593 \right) \frac{\text{kcal}}{\text{day}}$

Basal energy

Harris JA, Benedict FG (1918). "A Biometric Study of Human Basal Metabolism". Proceedings of the National Academy of Sciences of the United States of America. 4 (12): 370–3.

A Biometric Study of Basal Metabolism in Man. J. Arthur Harris and Francis G. Benedict. Washington, DC: Carnegie Institution, 1919.

Minimum energy and emissions

((-55.0969 + (0.6309 x **HR**) + (0.1988 x **W**) + (0.2017 x **A**))/4.184) x 60 x **T**

Activity energy **kcal**

((-20.4022 + (0.4472 x **HR**) - (0.1263 x **W**) + (0.074 x **A**))/4.184) x 60 x **T**

HR = Heart rate (in beats/minute)

W = Weight (in kilograms)

A = Age (in years)

T = Exercise duration time (in hours)

Baseline Emissions?

Metabolic Work Rate (Watts or J/s)

MWR = - 1967 + 8.58 HR + 25.1 HT + 4.50 A – 7.47 RHR + 67.8 G

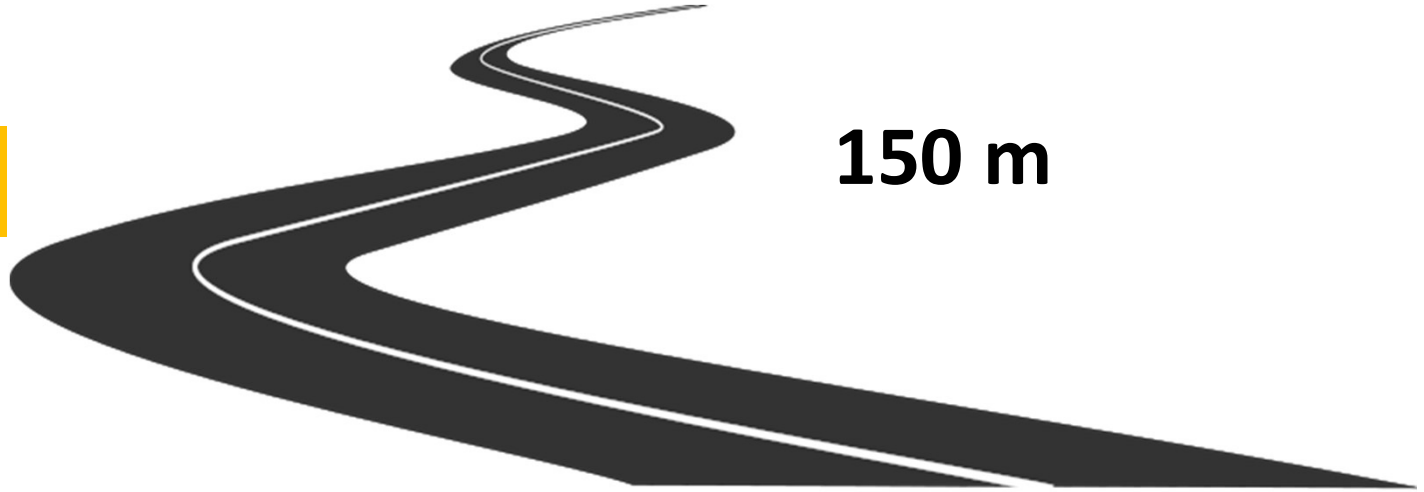
Where,
HR is heart rate (bpm)
HT is height (in.)
A is age (yr),
RHR is resting heart rate (bpm)
G is gender (M=0, F=1).

@ Predictive Models for Estimating Metabolic Workload based on Heart Rate and Physical Characteristics

Minimum energy and emissions

Example: P#1

Active modes



150 m

	Height (cm)	W (kg)	BPM basal	BPM walking	A	Sex	T (s)
Margarida	161	63	76	88	17	F	137
Catarina	161	54	76	84	16	F	133
Mariana	164	60	80	160	16	F	43
Joana	158	47.5	64	84	16	F	126.6
Mariana	178	60	76	92	16	F	126.6

Minimum energy and emissions

1 kcal = 0.0041868 MJ

MJ/day/((24h*3600s/h)/day)*time_exercise

1 kcal = 0.0041868 MJ;

Basal (kcal/dia)	Basal (MJ/dia)	Basal (MJ)	Walking (kcal)	Walking (MJ)
1455.322	6.09314215	0.00966158	6.686553936	0.018333684
1376.429	5.762832937	0.008871028	6.106641173	0.016696258
1441.205	6.034037094	0.003003051	7.666106597	0.029093404

(Walking-Basal)/distance

0.12 MJ/pkm
0.11 MJ/pkm
0.19 MJ/pkm
0.12 MJ/pkm
0.14 MJ/pkm

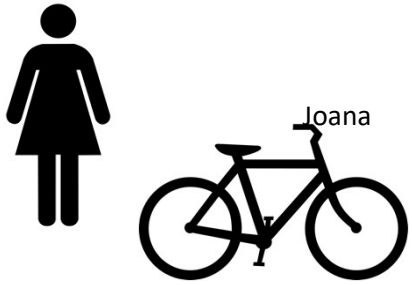
Minimum energy and emissions

Height (cm)	Weight (kg)	BPM basal	BPM exercise	Age	Sex	
171	53	68	128	17	M	Luis
165	55	56	108	17	F	Joana
183	62	89	160	15	M	João
174	67	68	116	17	M	Francisco
183	73	76	104	17	M	João

Minimum energy and emissions

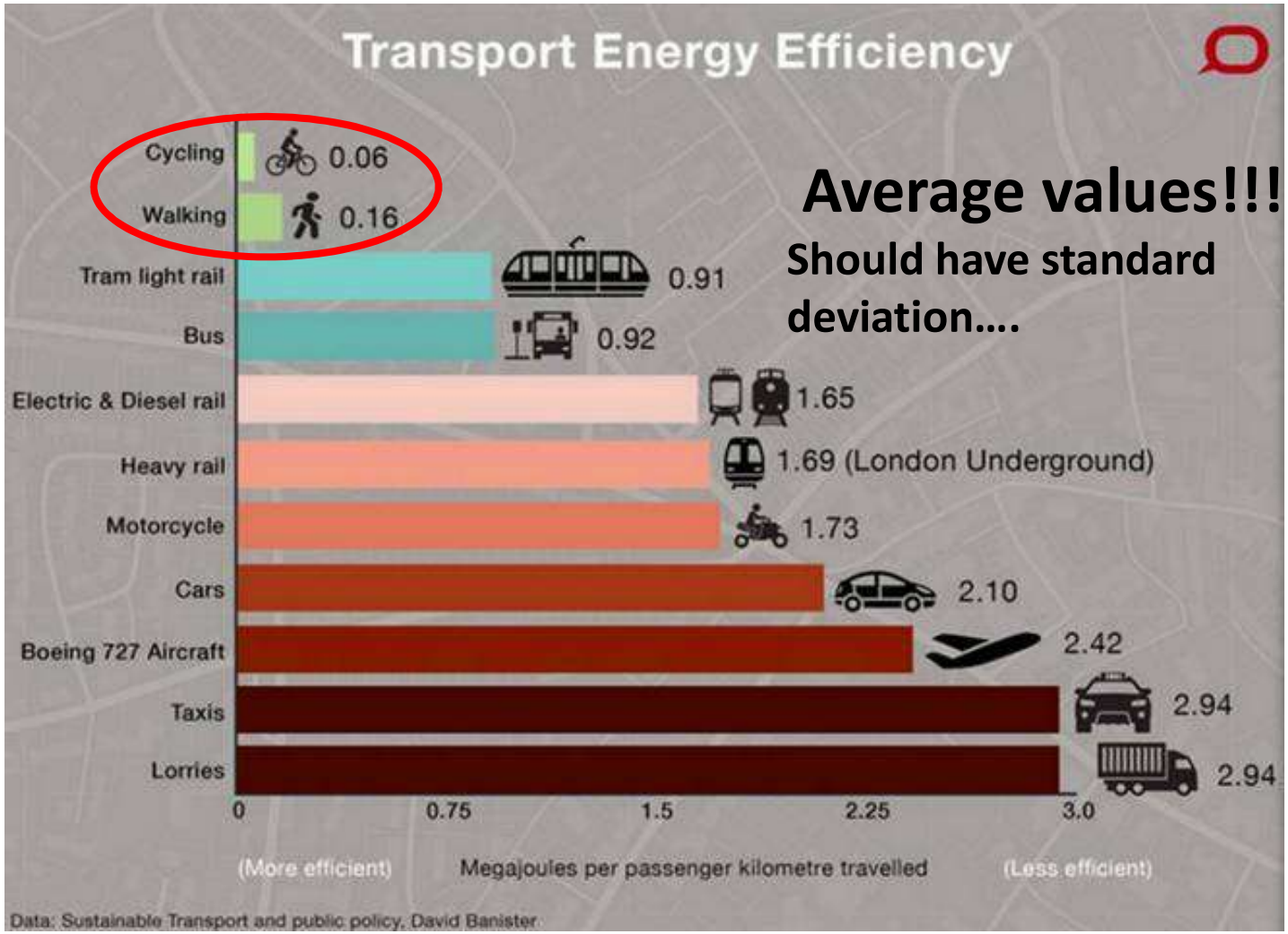
	Tempo (s)	Energia basal (kcal/dia)	Energia basal (MJ/dia)	**Energia basal (MJ)**	Energia (kcal)	**Energia (MJ)**
Luis	32	1522.523	6.374499296	0.00236093	8.93665233	0.03505505
João	37	1712.038	7.167960698	0.00306961	10.4489281	0.040677959
Francisco	41	1724.478	7.22004449	0.003426179	5.689435946	0.020394352
João	42	1848.051	7.737419927	0.003761246	4.761137667	0.016172685

0.23	**MJ/pkm**
0.07	**MJ/pkm**
0.14	**MJ/pkm**
0.11	**MJ/pkm**
0.27	**MJ/pkm**



Joana	34	1393.738	5.835302258	0.0022963	3.00762667	0.010296032

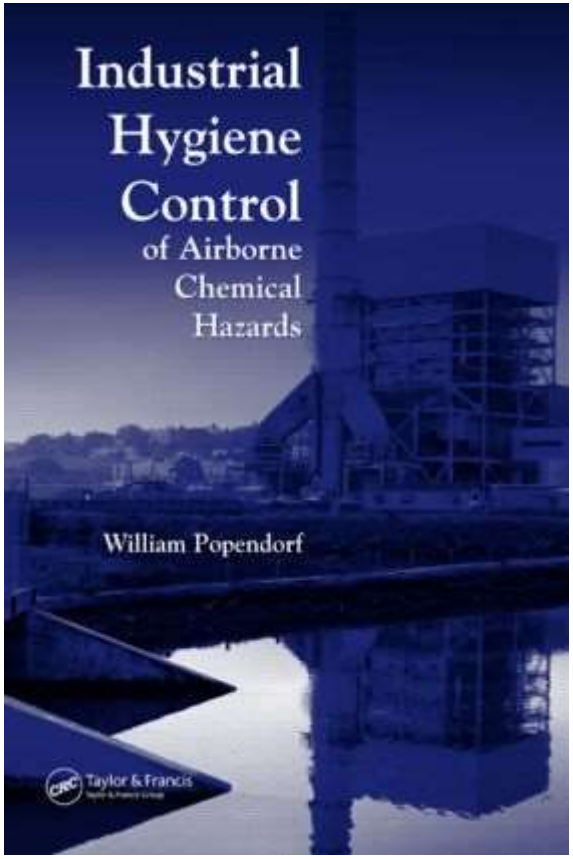
UK transport energy efficiency



Average values!!!!!

Should have standard deviation….

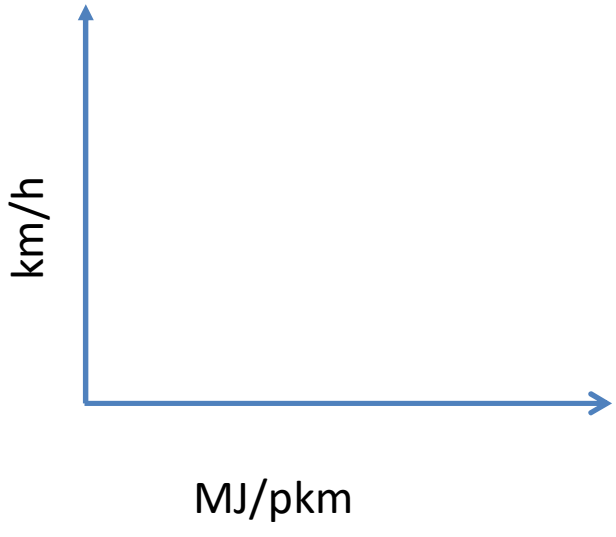
Biogenic CO_2

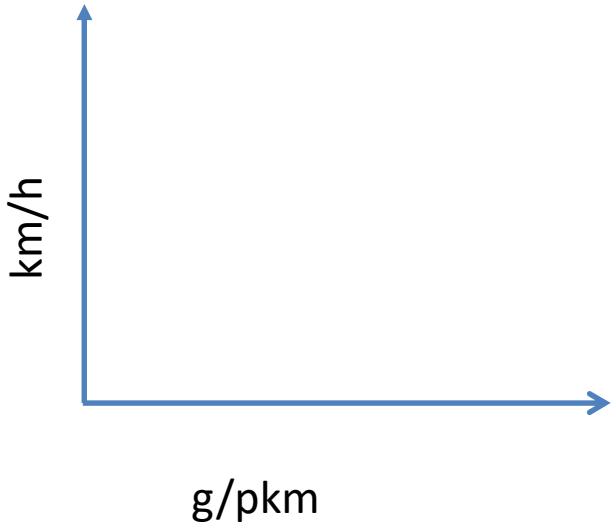


0.075 gCO_2/MJ

Estimate your energy for regular walking (at least 3 repetitions of the measurements), in MJ/pkm, and speed (km/h). What would be your graph?

Excel file by e-mail

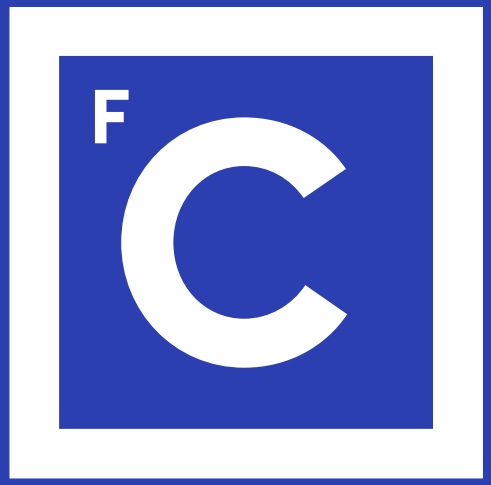




You learned….

- Share in final energy and emissions;
- Calculating energy baseline for mobility-walking;
- Biogenic emissions.

Obrigado



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