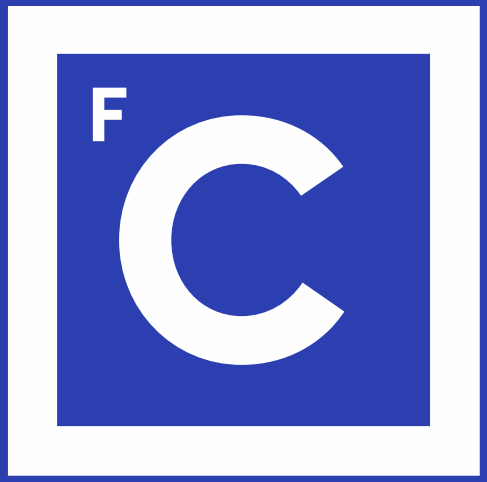


Ciências ULisboa

Faculdade
de Ciências
da Universidade
de Lisboa

DISCIPLINA MIEA 2018

Mobilidade Sustentável

Energy and emissions

Home ⟷ **Work/ University**

on a regular basis

Commuting by motorized or soft modes

Emissions ↑

Energy →

Emissions g/km

EMEP/EEA air pollutant emission inventory guidebook

Emissions g/km

EMEP/EEA air pollutant emission inventory guidebook

- Part B: sectoral guidance chapters
  - 1. Energy
    - 1.A Combustion
      - 1.A.1 Energy industries [2.4 MB]
      - 1.A.2 Manufacturing industries and construction [893.2 KB]
      - 1.A.3.a Aviation 2016 [1.5 MB]
      - 1.A.3.b.i-iv Road transport 2016 [3.3 MB]
      - 1.A.3.b.i-iv Road transport Annex HDVs 2016 [3.0 MB]
      - 1.A.3.b.v Gasoline evaporation 2016 [861.2 KB]
      - 1.A.3.b.vi-vii Road tyre and brake wear 2016 [542.7 KB]
      - 1.A.3.c Railways 2016 [476.0 KB]
      - 1.A.3.d Navigation (shipping) 2016 [804.2 KB]
      - 1.A.3.e.i Pipeline transport 2016 [93.3 KB]
      - 1.A.4 Small combustion 2016 [3.5 MB]
      - 1.A.4 Non road mobile machinery 2016 [1.7 MB]
      - 1.A.4 Non road mobile machinery Annex [99.6 KB]

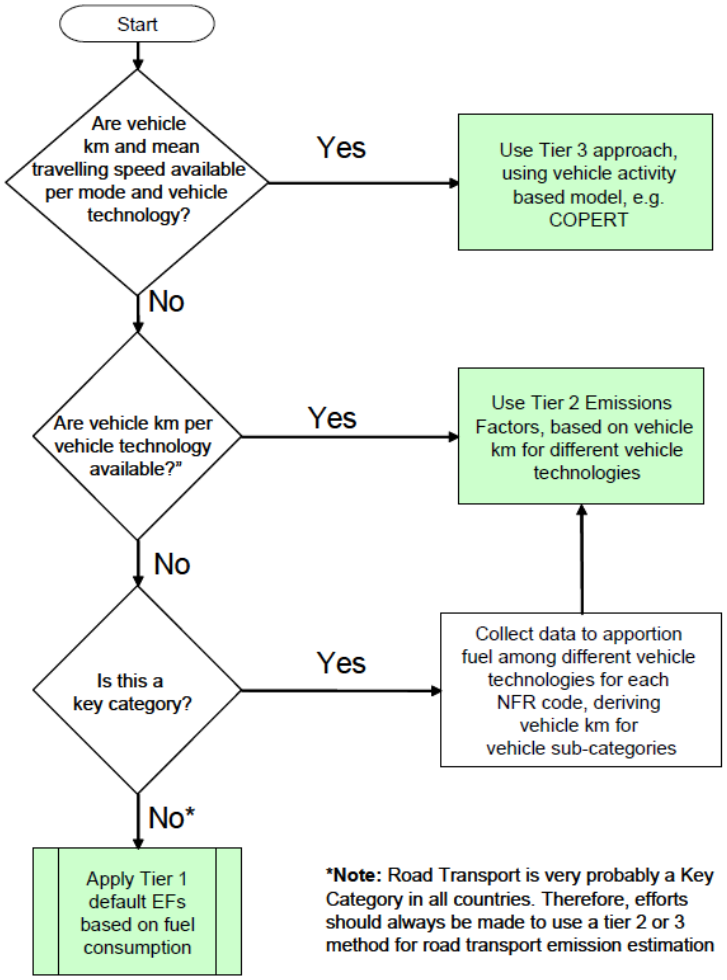
Not electric rail!

Emissions g/km

1.A.3.b.i, 1.A.3.b.ii, 1.A.3.b.iii, 1.A.3.b.iv

Passenger cars, light commercial trucks, heavy-duty vehicles including buses and motor cycles

Figure 3-1 Decision tree for exhaust emissions from road transport

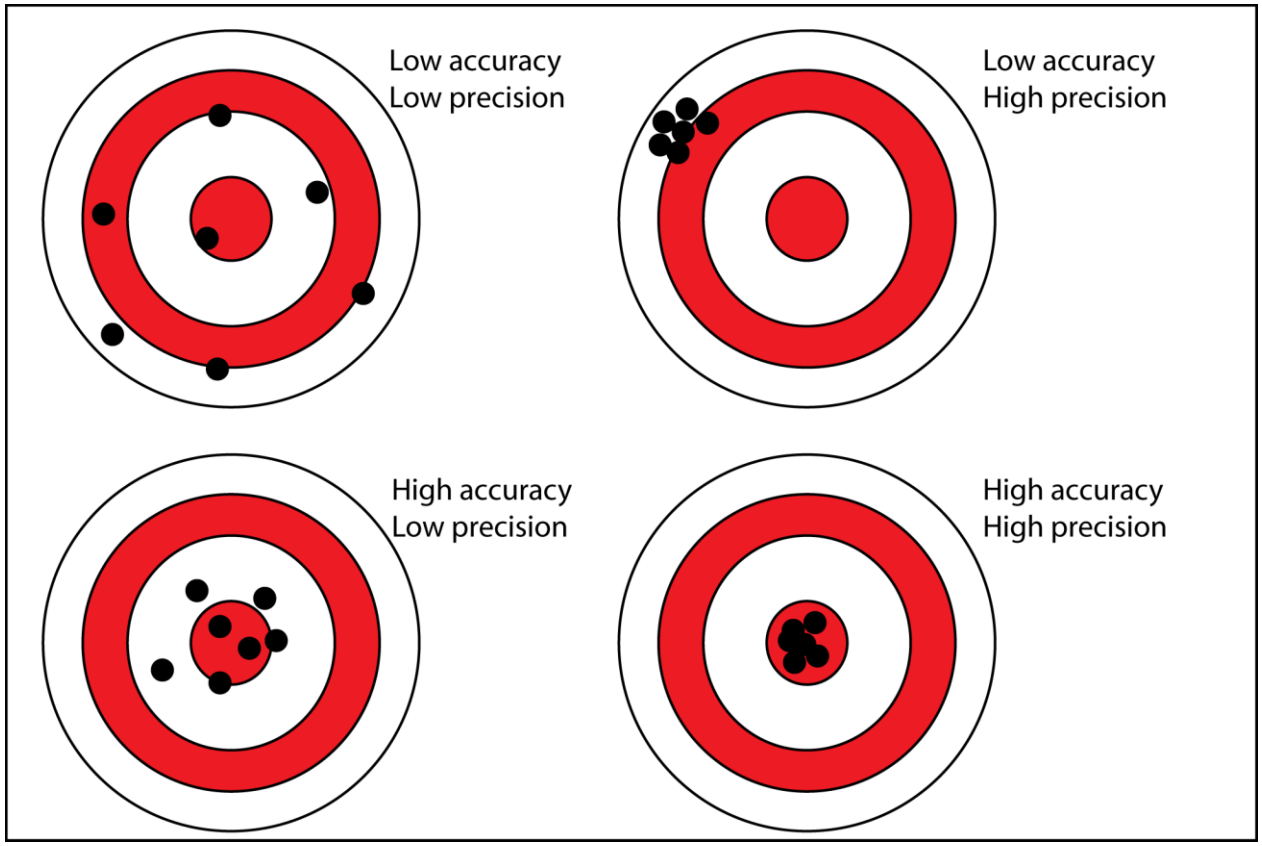


Community 10 people

	VCA/standard	Tier 1 EEA	Tier 2 EEA	Tier 3 EEA (COPERT)
MJ/year	12052	16957	12338	
TonCO_2/year	0.619	1.245	0.91	
kgNOx/year	0.3	4.5	2.75	
kgPM/year	0.01	0.23	0.018	

Tier 3…should be more accurate

Surveys, energ. & emissions



Tier 3…should be more accurate

STATE OF THE COMMUTE NATIONAL CAPITAL REGION

Commuter Connections TDM Evaluation Project

Nicholas Ramfos
Transportation Operations Programs Director

Transportation Planning Board
September 18, 2019
Item 8

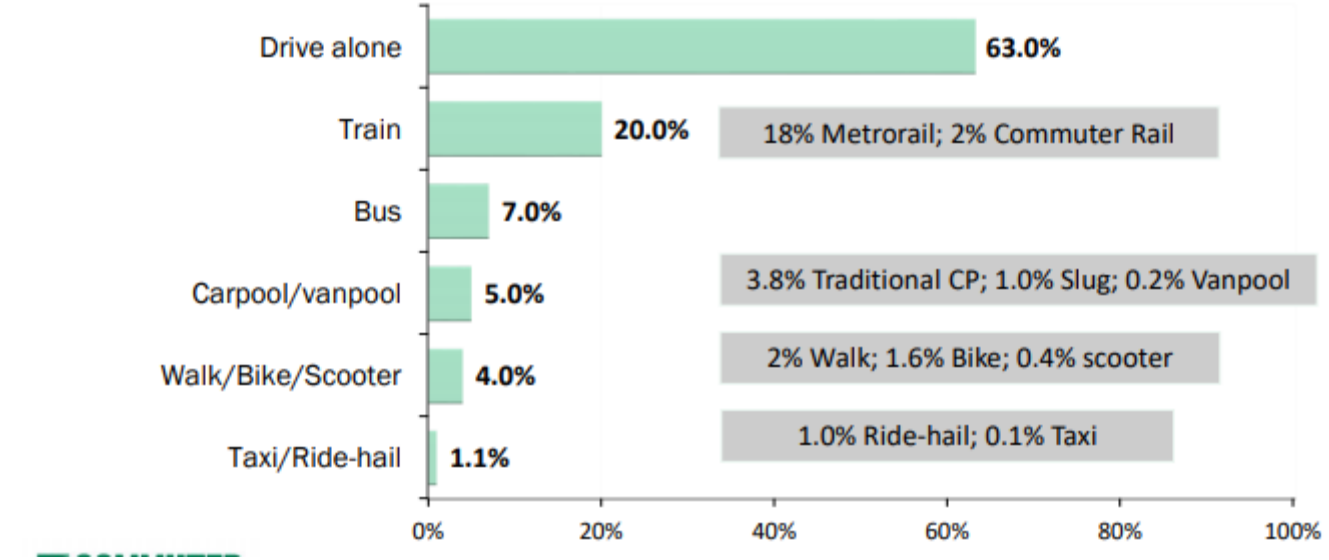
COMMUTER CONNECTIONS
A SMARTER WAY TO WORK

Surveys, energ. & emissions

Commute Patterns - Primary Mode

Of the work trips made (omits teleworking and compressed work schedules), which are 10% of total trips):

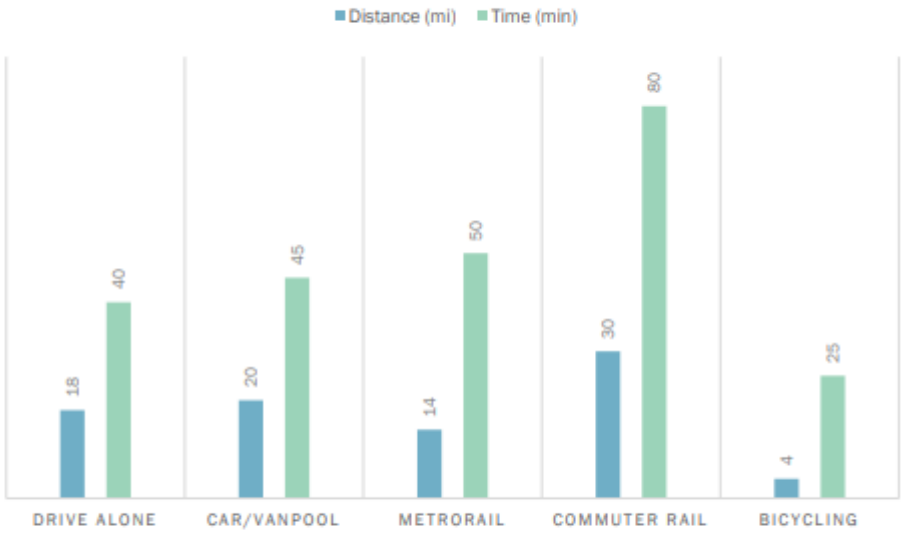
- Majority of work trips – drive alone; continued decrease since 2004
- About a quarter use public transportation; continued increase since 2004
- Very small share use ride hailing services

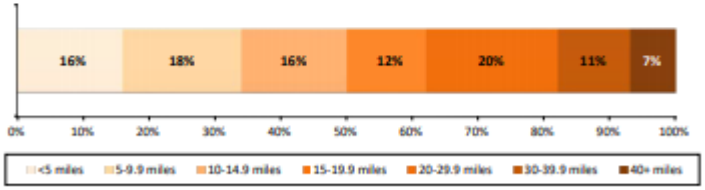


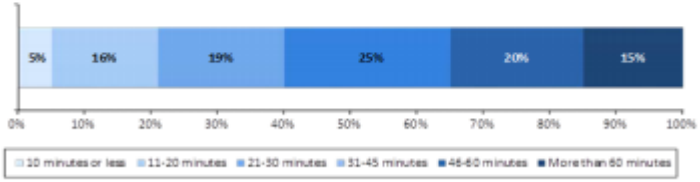
Surveys, energ. & emissions

Commute Patterns - Travel Details

- The regional average commute length is 17 miles
- The regional average commute time is 43 minutes
- Average travel length has not changed since 2004
- Average travel time now is 26% longer than in 2004





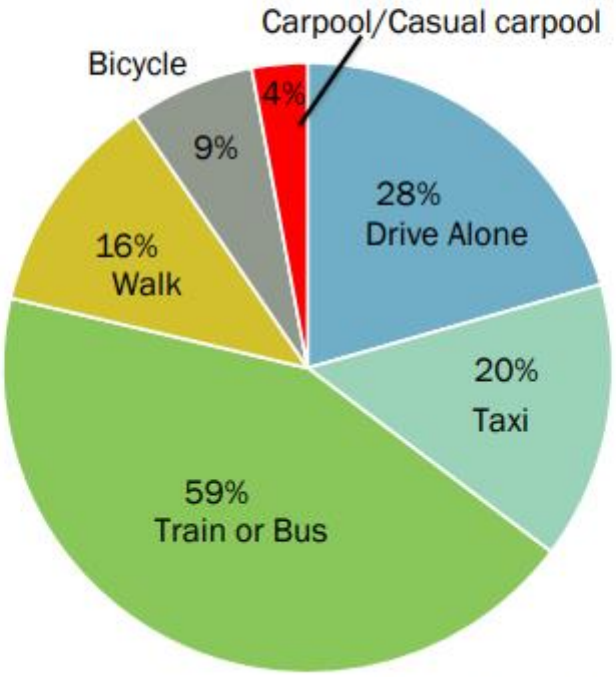


COMMUTER

Surveys, energ. & emissions

Commute Patterns - Ride-hailing

- Constitutes very small share of primary commute (1% of 3.1M trips/day)
- Without ride-hailing these commute trips would have been made:



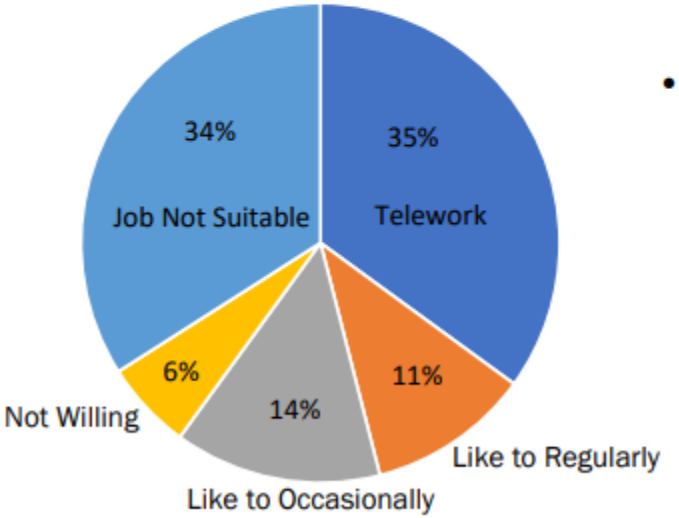
COMMUTER CONNECTIONS
A SMARTER WAY TO WORK

Agenda Item #8 Briefing on the State of the Commute Report
September 18, 2019 | 9

Surveys, energ. & emissions

Commute Options and Attitudes – Potential for Telework

Of the 3.1M daily commuters – approximately 1 million telework an average 1.2 days/week.



- Teleworking can be increased among an additional 775,000 who do not telework and would like to telework

COMMUTER CONNECTIONS
A SMARTER WAY TO WORK

Agenda Item #8 Briefing on the State of the Commute Report
September 18, 2019 | 17

Surveys, energ. & emissions

Boats…Tagus river…..

SofLusa
Transtejo

Energy consumption….MJ/pkm

Características principais | Características técnicas

Nomes dos navios: Damião de Goes, Miguel Torga, Fernando Namora, Gil Vicente, Jorge de Sena, Almeida Garrett, Fernando Pessoa e Antero de Quental

Classe navio: Catamarã
Serviço: Soflusa
Ligação: Barreiro – Terreiro do Paço
Entrada ao serviço: desde 2003
Capacidade: 600 passageiros
N.º de salões: 2
Outras caraterísticas: música ambiente, bar, instalações sanitárias, incluindo uma para pessoas com deficiência.

Energy consumption….MJ/pkm

Características principais | Características técnicas

Comprimento: 49,20m
Boca: 12,30m
Pontal: 3,30m
Calado: 1,58m
Arqueação Bruta: 713 tons
Catamarã em alumínio
Funcionamento e Sistem[illegible]ulsão
Velocidade de Serviço: 22 Nós
Velocidade Máxima: 30 Nós
Motor Principal: mtu 16V40000M70
Propulsão: 2 jactos de água Hamilton
Construção: Estaleiro Damen Shipyards, Singapura

~ 40 km/h

Energy consumption….MJ/pkm

Tabela 11

Indicadores de eficiência energética da frota de navios – 2014 vs 2013

	Transtejo			Soflusa			Grupo		
Consumo Especifico da Frota de Navios	2014	2013	Δ 2014/13	2014	2013	Δ 2014/13	2014	2013	Δ 2014/13
Consumo médio por passageiro (l/p)	0,377	0,350	7,71	0,620	0,635	-2,36	0,481	0,470	2,34
Consumo por lugar quilómetro (l/lkm)	0,024	0,022	9,09	0,024	0,024	0,00	0,024	0,023	4,35
Consumo passageiro quilómetro (l/pkm)	0,088	0,081	8,64	0,062	0,063	-1,59	0,071	0,070	1,43
Consumo de combustível por viagem (l/vg)	53,846	51,026	5,53	142,401	146,353	-2,70	82,177	81,283	1,10

NEED MORE PASSENGERS??
ECONOMIC DRIVING??

0.062 Ldiesel marine/pkm = 0.062*35 MJ/L = 2.17 MJ/pkm!!!!!!!!!

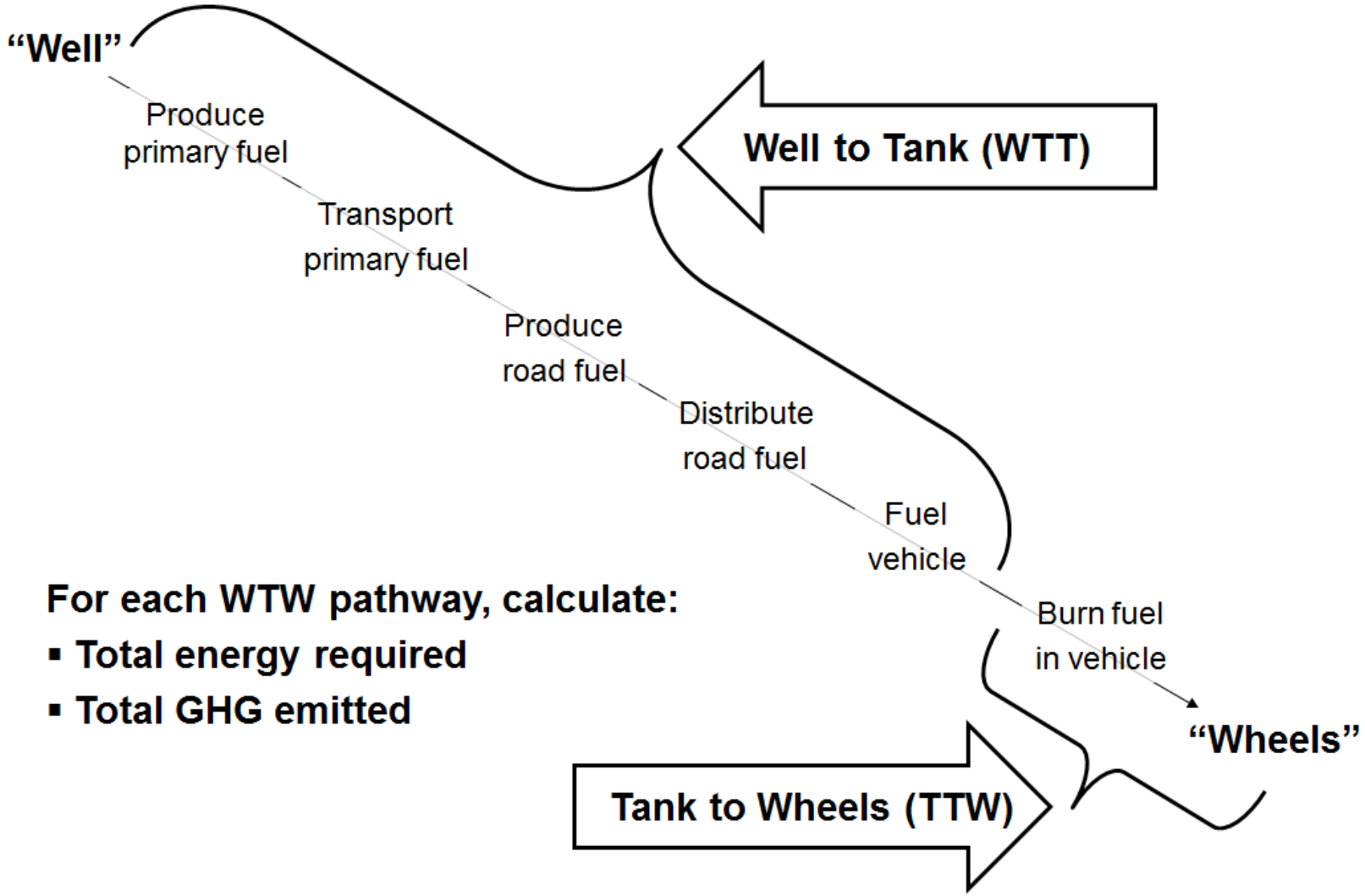
Emissions g/km

EMEP/EEA air pollutant emission inventory guidebook

- Part B: sectoral guidance chapters
  - 1. Energy
    - 1.A Combustion
      - 1.A.1 Energy industries [2.4 MB]
      - 1.A.2 Manufacturing industries and construction [893.2 KB]
      - 1.A.3.a Aviation 2016 [1.5 MB]
      - 1.A.3.b.i-iv Road transport 2016 [3.3 MB]
      - 1.A.3.b.i-iv Road transport Annex HDVs 2016 [3.0 MB]
      - 1.A.3.b.v Gasoline evaporation 2016 [861.2 KB]
      - 1.A.3.b.vi-vii Road tyre and brake wear 2016 [542.7 KB]
      - 1.A.3.c Railways 2016 [476.0 KB]
      - 1.A.3.d Navigation (shipping) 2016 [804.2 KB]
      - 1.A.3.e.i Pipeline transport 2016 [93.3 KB]
      - 1.A.4 Small combustion 2016 [3.5 MB]
      - 1.A.4 Non road mobile machinery 2016 [1.7 MB]
      - 1.A.4 Non road mobile machinery Annex [99.6 KB]

Not electric rail!

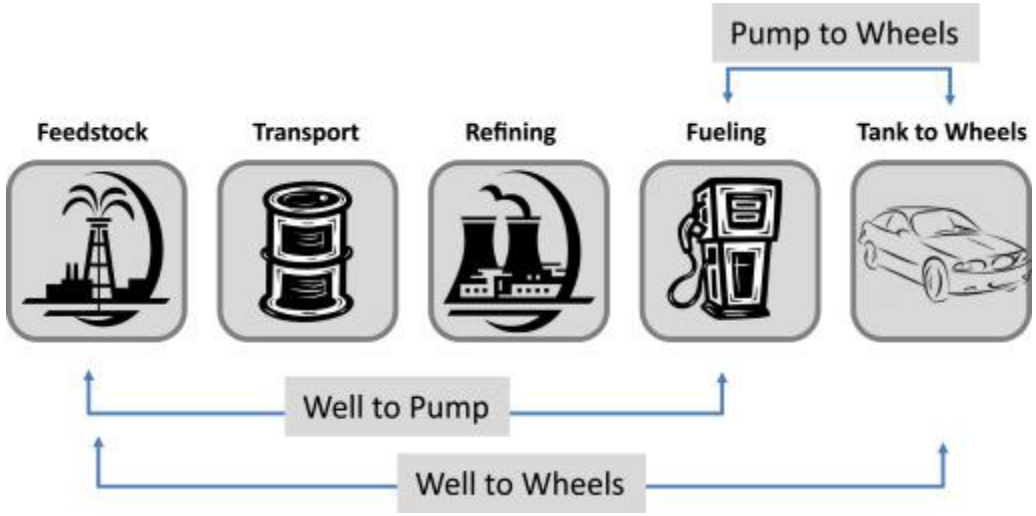
Survey sustainable mobility



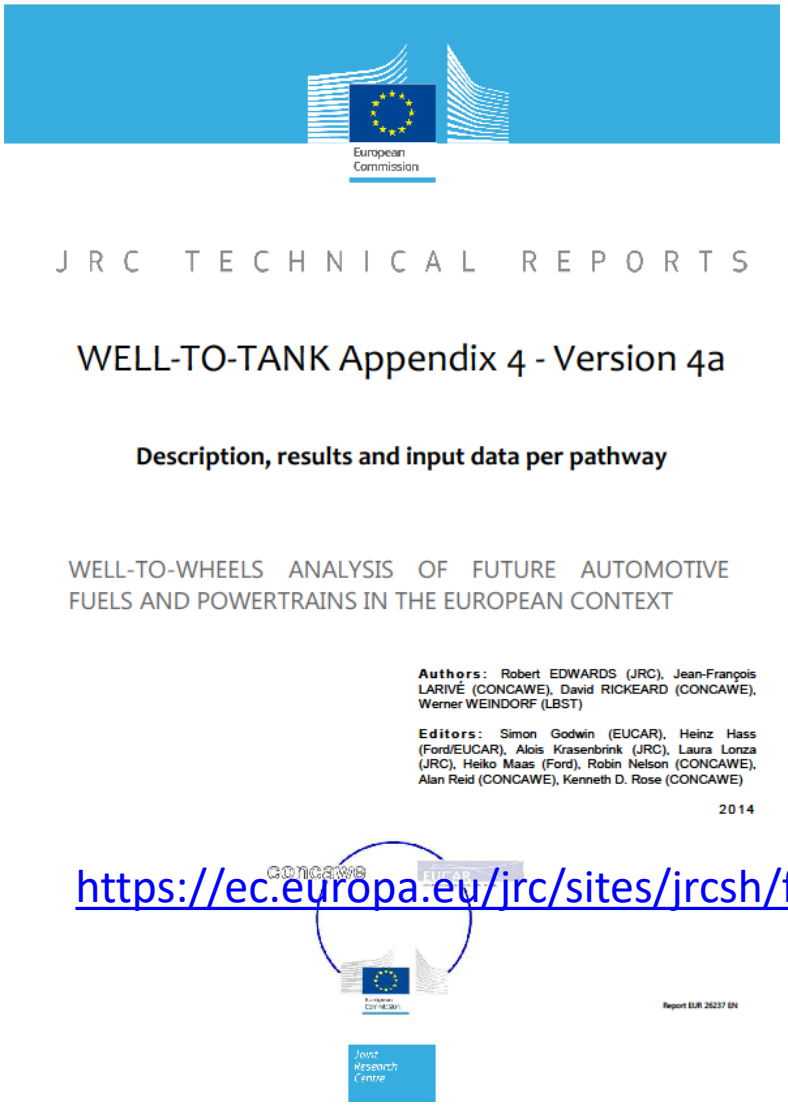
For each WTW pathway, calculate:

- **Total energy required**
- **Total GHG emitted**

Survey sustainable mobility

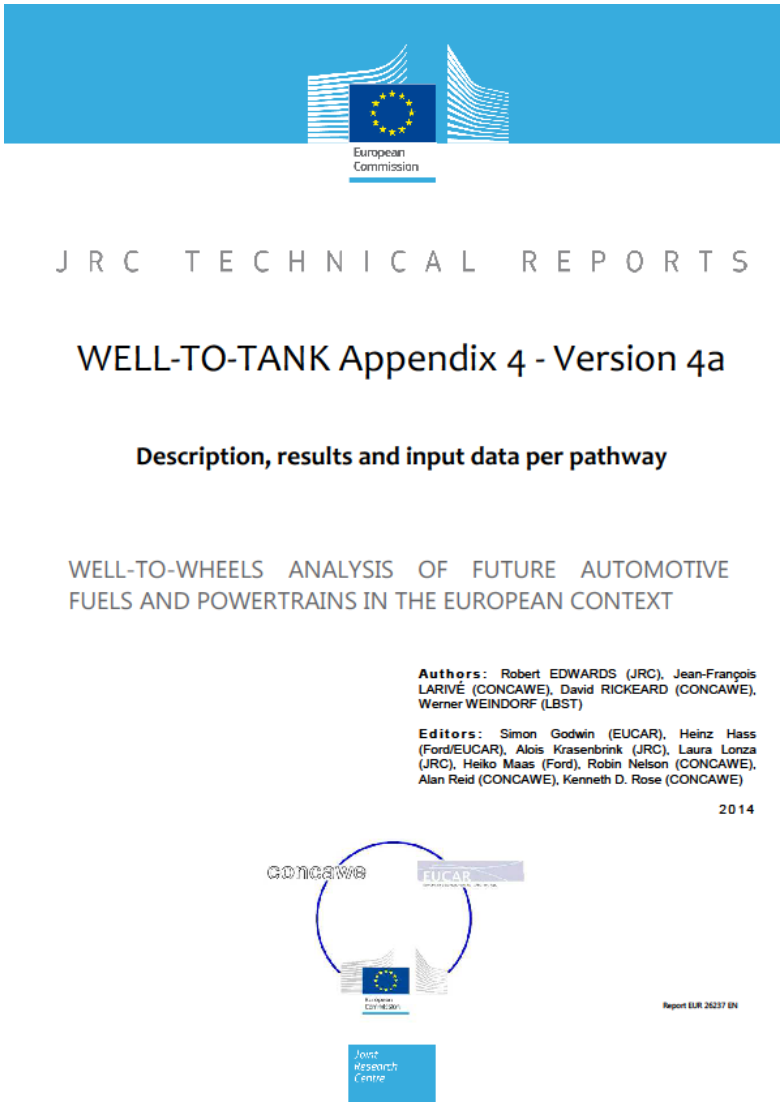


Survey sustainable mobility



https://ec.europa.eu/jrc/sites/jrcsh/files/wtt_appendix_4_v4_july_2013_final2.pdf

Survey sustainable mobility



1 **Oil and gas**

WTT v4a pathways
1-Oil & Gas rep.xlsx

2 **Biogas and Synthetic Methane**

WTT v4a pathways
2-CBG rep.xlsx

3 **Ethanol**

WTT v4a pathways
3-Ethanol rep.xlsx

4 **Biodiesel**

WTT v4a pathways
4-Biodiesel rep.xlsx

5 **Synfuels**

WTT v4a pathways
5-Synfuels rep.xlsx

6 **Electricity**

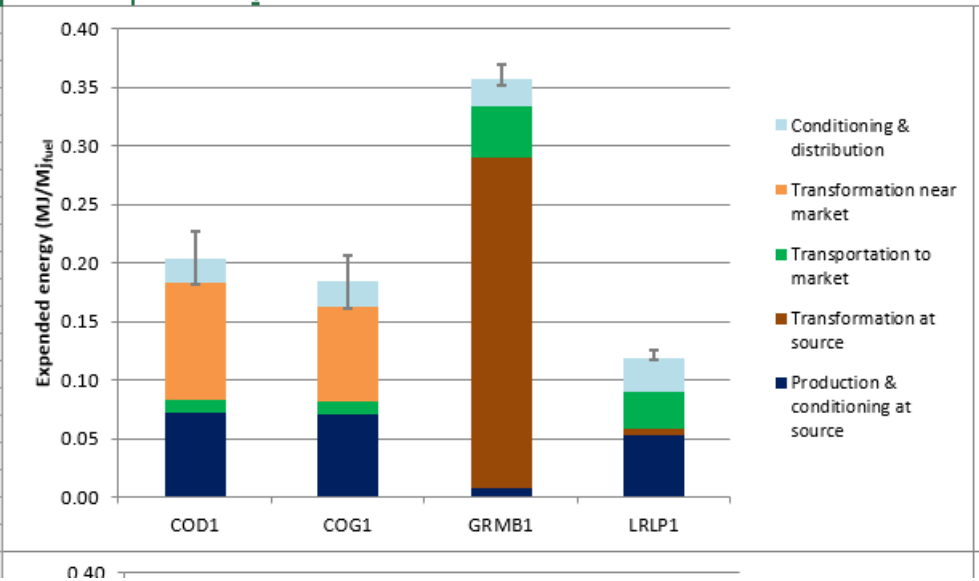
JEC WTW study Version 4

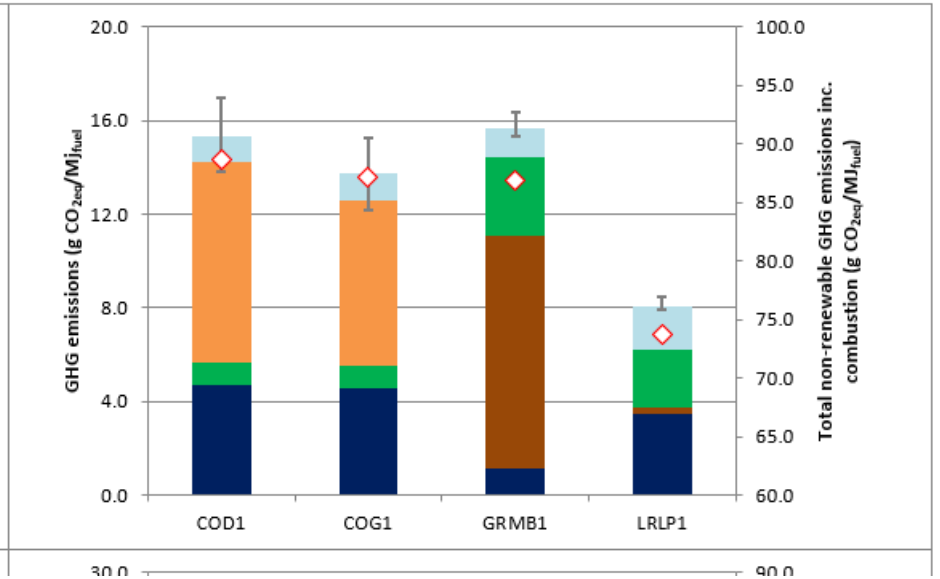
WTT pathways

Conventional oil-based fuels and CNG

Back to menu

Code	Final fuel	Expended energy (MJ/MJ fuel)								GHG emissions (g CO 2eq/MJ fuel)						
		Total	Fossil	Nuclear	Production & conditioning at source	Transformation at source	Transportation to market	Transformation near market	Conditioning & distribution	**Total**	Production & conditioning at source	Transformation at source	Transportation to market	Transformation near market	Conditioning & distribution	**Total non-renewable inc. combustion**
COD1	Diesel fuel	**0.20**	0.20	0.01	0.07		0.01	0.10	0.02	**15.4**	4.7		1.0	8.6	1.1	**88.6**
COG1	Gasoline	**0.18**	1.18	0.01	0.07		0.01	0.08	0.02	**13.8**	4.6		1.0	7.0	1.2	**87.1**
GRMB1	MTBE	**0.36**	0.35	0.01	0.01	0.28	0.04		0.02	**15.6**	1.13	9.91	3.37		1.24	**86.9**
LRLP1	LPG	**0.12**	0.11	0.00	0.05	0.00	0.03		0.03	**8.0**	3.5	0.3	2.5		1.8	**73.7**
GMCG1	CNG	**0.16**	0.13	0.03	0.03		0.06		0.08	**13.0**	4.0		5.1		3.9	**69.3**
GPCG1a		**0.29**	0.26	0.03	0.03		0.18		0.08	**22.6**	4.4		14.3		3.9	**77.6**
GPCG1b		**0.21**	0.18	0.03	0.03		0.10		0.08	**16.1**	4.1		8.1		3.9	**71.1**
GRCG1		**0.31**	0.28	0.03	0.03	0.10	0.07		0.12	**21.1**	4.1	6.3	4.9		5.7	**76.1**
GRCG1C		**0.33**	0.29	0.03	0.03	0.11	0.07		0.12	**17.8**	4.1	3.0	4.9		5.7	**72.9**
GRCG2		**0.26**	0.25	0.01	0.03	0.10	0.07		0.07	**21.3**	4.1	6.3	4.9		6.1	**76.4**
GRLG1	LNG	**0.22**	0.22	0.00	0.03	0.09	0.07		0.03	**19.4**	4.0	6.2	4.8		4.4	**74.5**
SGCG1	CNG	**0.10**	0.07	0.03	0.02				0.08	**7.8**	3.9				3.9	**62.8**





Carla Silva camsilva@fc.ul.pt

Surveys, energ. & emissions

Example:

Energy consumption:

Diesel bus consumption TTW: 617 MJ/year (tier 2 community 10 people)

WTT: 0.2*617

WTW: 0.2*617+617

CO2eq emissions g:
WTT: 15.4*617

WTW: 15.4*617+617*73

Surveys, energ. & emissions

JEC WTW study Version 4

WTT pathways *Last saved on 17/07/13*

Electricity LV (400 V)

Go to summary

Code	*Feedstock*	*Description*
EMEL	EU-mix	EU-mix electricity (High,Medium and Low voltage)
FOEL	HFO	Heavy fuel oil in conventional power plant
KOEL	Hard coal	Hard coal in conventional power plant or IGCC (with/without CCS)
GxEL	NG	Imported natural gas (7000 and 4000 km) and LNG in state-of-the-art CCGT
OWEL	Biogas	Biogas from municipal waste and manure, on-site generation or export to large scale power plant
WxEL	Wood	Farmed and waste wood in 4 different power plants (large/small scale IGCC, conventional, co-firing in large coal plant) plus waste wood through black liquor
NUEL	Nuclear	Nuclear power plant
WDEL	Wind	Wind turbine

Agri inputs
Common

The EU-mix pathways represent actual EU averages, based on national statistics. Other pathways where a specific energy source is used generally represent state-of-the-art processes that are likely to be applied in new plants. They are therefore not representative of the current EU population of plants using the particular type of energy source.

For additional information, refer to section 3.5 of the ***WTT report****.*

We have represented wind energy as one of the fully renewable electricity sources. Other pathways such as hydropower, tidal etc would yield very similar numbers, with a small amount of energy and virtually no GHG emissions (as we do not consider emissions related to construction and maintenance).

Surveys, energ. & emissions

JEC WTW study Version 4

WTT pathways

Electricity LV (400 V)

Back to menu

Code	Feedstock	Expended energy (MJ/MJ fuel)									GHG emissions (g CO 2eq/MJ fuel)					
		Total	Fossil	Nuclear	Renewable	Production & conditioning at source	Transformation at source	Transportation to market	Transformation near market	Conditioning & distribution	Total	Production & conditioning at source	Transformation at source	Transportation to market	Transformation near market	Conditioning & distribution
EMEL1	EU-mix HV	**1.94**	0.62	1.13	0.30				1.92	0.02	**136.0**				136.0	0.0
EMEL2	EU-mix MV	**2.05**	0.62	1.13	0.30				2.00	0.05	**141.1**				141.1	0.0
EMEL3	EU-mix LV	**2.24**	0.73	1.20	0.32				2.12	0.12	**150.1**				150.1	0.0
FOEL1	HFO	**1.94**	1.94	0.00	0.00				1.82	0.12	**237.8**				237.8	0.0
KOEL1	Hard coal	**1.81**	1.78	0.03	0.00	0.23			1.46	0.12	**292.4**	41.2			251.2	0.0
KOEL2		**1.54**	1.52	0.03	0.00	0.21			1.21	0.12	**262.4**	37.3			225.1	0.0
KOEL2C		**1.98**	1.94	0.03	0.00	0.24			1.61	0.12	**71.0**	43.7			27.4	0.0
GPEL1a	NG	**1.35**	1.35	0.00	0.00	0.06		0.37	0.81	0.12	**145.0**	8.6		28.6	107.8	0.0
GPEL1b		**1.19**	1.19	0.00	0.00	0.05		0.21	0.81	0.12	**132.4**	8.0		16.6	107.8	0.0
GPEL1bC		**1.71**	1.71	0.00	0.00	0.06		0.26	1.26	0.12	**44.7**	9.9		20.5	14.3	0.0
GREL1		**1.39**	1.39	0.00	0.00	0.05	0.18	0.22	0.81	0.12	**141.6**	7.9	12.2	14.1	107.4	0.0
OWEL1a	Biogas	**3.40**	-0.10	0.00	3.50				3.34	0.06	**13.6**				13.6	0.0
OWEL1b		**2.70**	-0.73	0.23	3.20				2.58	0.12	**23.8**				23.8	0.0
OWEL21a		**5.69**	0.04	0.00	5.65			0.04	5.58	0.06	**-175.5**	-199.4		3.3	20.6	0.0
OWEL21b		**4.66**	-0.79	0.12	5.33			0.04	4.50	0.12	**-139.6**	-159.0		2.7	16.7	0.0
OWEL22a		**6.04**	0.05	0.00	6.00			0.05	5.93	0.06	**-116.0**	-209.9		3.5	90.4	0.0
OWEL22b		**4.97**	-0.79	0.12	5.63			0.04	4.81	0.12	**-63.1**	-168.0		2.8	102.0	0.0
WFEL1	Wood	**1.44**	0.05	0.00	1.38	0.10		0.01	1.20	0.12	**7.9**	5.6		0.8	1.6	0.0
WFEL2		**2.32**	0.07	0.00	2.24	0.14		0.01	2.04	0.12	**10.8**	7.6		1.0	2.1	0.0
WFEL3		**2.67**	0.08	0.00	2.59	0.15		0.02	2.38	0.12	**14.0**	8.5		1.1	4.4	0.0
WFEL4		**1.70**	0.06	0.00	1.64	0.11		0.01	1.46	0.12	**11.0**	6.2		0.8	3.9	0.0
WWEL1		**1.43**	0.05	0.00	1.38	0.07		0.04	1.20	0.12	**5.3**	0.8		2.9	1.6	0.0
WWEL2		**2.27**	0.03	0.00	2.24	0.09		0.01	2.04	0.12	**4.3**	1.1		1.0	2.1	0.0
WWEL3		**2.62**	0.03	0.00	2.59	0.10		0.02	2.38	0.12	**6.8**	1.3		1.1	4.4	0.0
WWEL4		**1.69**	0.05	0.00	1.64	0.08		0.04	1.46	0.12	**8.1**	0.9		3.3	3.9	0.0
WWEL5		**0.29**	0.01	0.00	0.28	0.04		0.01	0.12	0.12	**0.9**	0.4		0.4	0.0	0.0
NUEL	Nuclear	**2.40**	0.06	3.01	0.01	0.00			2.28	0.12	**0.4**	0.1			0.3	0.0
WDEL	Wind	**0.12**	0.00	0.00	0.12				0.00	0.12	**0.0**				0.0	0.0

Surveys, energ. & emissions

Example:

B-Battery (EU-mix medium voltage)

If eletric consumption BTW: 100 kWh/year

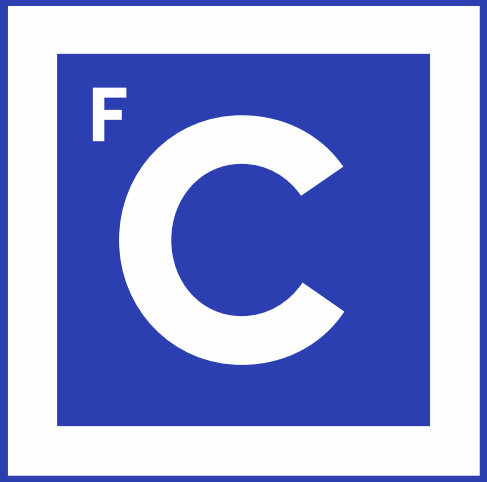
WTB: 2.05*100 kWh

WTW: 3.05*100 kWh

CO2eq emissions g:
WTB: 141.1*3.6*100

WTW: WTB

Obrigado



Ciências ULisboa

Faculdade
de Ciências
da Universidade
de Lisboa